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SCIENCE AND TECHNOLOGY ACT OF 1958

UNIVERSITY
OF MICHIGAN

JUN 16 1958

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HEARINGS

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON GOVERNMENT OPERATIONS UNITED STATES SENATE

EIGHTY-FIFTH CONGRESS

SECOND SESSION

ON

S. 3126

A BILL TO CREATE A DEPARTMENT OF SCIENCE AND TECHNOLOGY; (TO CREATE STANDING COMMITTEES ON SCIENCE AND TECHNOLOGY IN THE CONGRESS); TO ESTABLISH NATIONAL INSTITUTES OF SCIENTIFIC RESEARCH; TO AUTHORIZE A PROGRAM OF FEDERAL LOANS AND LOAN INSURANCE FOR COLLEGE OR UNIVERSITY EDUCATION IN THE PHYSICAL OR BIOLOGICAL SCIENCES, MATHEMATICS, OR ENGINEERING; TO AUTHORIZE THE ESTABLISHMENT OF SCIENTIFIC PROGRAMS OUTSIDE OF THE UNITED STATES; AND FOR OTHER PURPOSES

MAY 2, 6, AND 7, 1958

PART 1

Printed for the use of the Committee on Government Operations

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SCIENCE AND TECHNOLOGY ACT OF 1958

FRIDAY, MAY 2, 1958

UNITED STATES SENATE,
SUBCOMMITTEE ON REORGANIZATION OF THE
COMMITTEE ON GOVERNMENT OPERATIONS,
Washington, D. C.

The subcommittee met, pursuant to call, at 10:15 a. m., in room 357, Senate Office Building, Senator Hubert H. Humphrey (chairman of the subcommittee) presiding.

Present: Senators Humphrey, Thurmond, Lausche, and Martin of Iowa.

Also present: Walter L. Reynolds, chief clerk and staff director; Ann M. Grickis, assistant chief clerk; Miles Scull, Jr., professional staff member; W. E. O'Brien, professional staff member.

Senator HUMPHREY. I understand one of our witnesses would like to utilize a motion picture as part of the means of presenting his testimony. This is, as I was informed, rather unusual but these are rather unusual times. I think there is nothing that Congress needs any more than something that is unusual, so I am all for you using the motion picture.

I have come to the conclusion that they are here to stay, at least for a while and it might not be a bad idea if Congress would occasionally indulge itself in a little of the technique of audio and visual aids. We are strong on the audio, but short on the visual.

So, unless there is objection by some of my colleagues, we will grant permission for the use of the film at the appropriate time that the witness would like to have it presented.

These hearings by the Subcommittee on Reorganization of the Committee on Government Operations are being held as the first phase of the committee's study of necessary reorganizations of scientific activities of the Federal Government. The testimony to be submitted today, and on May 6 and 7, will be directed toward the development and support of a comprehensive program for the coordination of scientific and technical information.

I should add that the staff of the Committee on Governnent Operations and of this subcommittee has done a very fine job in preparatory work. The staff has published, or made available for the committee and public, an excellent staff report relating to the whole area of Federal responsibilities in scientific work and scientific activities. As I said on the floor of the Senate at the time that that report was authorized to be printed as a Senate document (S. Doc. 90), it is a staff report, and does not necessarily reflect the conclusions or the observations of members of the subcommittee. Nevertheless, it is a very worthwhile and very well documented study that can be of great help to those who are interested in this legislation.

One of the sections of the bill S. 3126, drafted by the staff of the committee after more than 6 months' study, provides for the expansion and coordination of Federal programs which have to do with assembling, translating. abstracting, storing, indexing, retrieving, and disseminating scientific information. In holding these hearings, the committee proposes to proceed on the assumption that existing laws are adequate to permit agencies of the Government operating in this area to provide the necessary facilities to initiate coordinated Federal programs without the necessity of enacting further enabling legislation.

The subcommittee, in holding these hearings, is proceeding on the assumption that many private and industrial abstracting, translating and research groups can provide most of this type of service to the Federal research programs and scientists in our universities and industries without the necessity of establishing a scientific dissemination service under the control of the Federal Government.

The immediate objective is to develop authentic information as to the extent these services are now being provided by private facilities engaged in the dissemination of scientific information, and to what extent the Federal Government should participate, either in the way of establishing a scientific information center or in providing funds in support of existing programs.

It is important that representatives of the non-Federal groups who will testify at the hearings understand that the committee's objective is not to replace any of these operations which may now be functioning in the various fields of science with Federal facilities, but to provide for Federal support of such existing or proposed private or industrial groups wherever needed.

With one exception, the witnesses invited to testify today participated in a discussion of these problems held by the Council for Documentation Research at Western Reserve University in Cleveland, Ohio, last February. At later hearings, scheduled for May 6 and 7, the committee expects to receive further testimony from other research agencies operating in behalf of the various fields of science and from groups which have developed suggestions for the establishment of adequate facilities, information centers or libraries, to attain these objectives.

Following the presentation of the views of those who represent the various sciences, universities, libraries, and industrial research, the committee will invite testimony from the various Federal agencies which are active in this field and are in a position to participate or support the proposed programs that will be outlined at the hearings.* Representatives of these agencies will be requested not only to comment on the merits of the various proposals submitted during the course of the first stages of the hearings, but also, to make their own suggestions as to what extent the Federal Government should participate in the way of organization of additional facilities and in financing existing or new programs.

I am sure that all witnesses who have been invited to participate in these hearings have the same general objective of improving the scientific and technical information services, private or governmental, so that all scientists, instructors, agencies, or industries engaged in scientific activities will have ready access to information which would be of value to them. Through these hearings, the subcommittee proposes to compile reliable information relative to existing facilities

* Scheduled for June 25 and 26, 1958.

engaged in assembling, coordinating, and distributing scientific information, and to make available to all committees of the Congress specific data upon which they may determine the extent to which the Federal Government should participate in these programs either by administrative action or through the allocation of funds wherever required.

I believe that all of us are agreed on the urgency and necessity of improving these services, and that practically every person who is competent in the scientific information field recognizes the existing deficiencies of such facilities and the essential need for improving them. We hope, as a result of these hearings, constructive action can be taken toward achieving this objective.

The bill S. 3126, which covers the area on which the present hearings are based, has been referred to the Special Committee on Space and Astronautics upon the motion of Senator Lyndon B. Johnson, chairman of that committee. The development of information on this phase of the program, however, has been left to the Committee on Government Operations under a cooperative agreement between the two committees. This committee will, under this agreement, defer any further hearings or action on other parts of the legislation proposed under S. 3126 until the Committee on Space and Astronautics has submitted its recommendations to the Senate. Witnesses are, therefore, urged to confine their testimony to the specific aspects of the program relating to assembling, documentation, and distribution of scientific information.

(S. 3126 is as follows:)

[S. 3126, 85th Cong., 2d sess.]

A BILL To create a Department of Science and Technology; to establish National Institutes of Scientific Research; to authorize a program of Federal loans and loan insurance for college or university education in the physical or biological sciences, mathematics, or engineering; to authorize the establishment of scientific programs outside of the United States; and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SHORT TITLE

SECTION 1. This Act may be cited as the "Science and Technology Act of 1958".

TITLE I—DEPARTMENT OF SCIENCE AND TECHNOLOGY

ESTABLISHMENT

SEC. 101. There is hereby established an executive department of the Government to be known as the United States Department of Science and Technology (hereinafter referred to as the "Department"), at the head of which shall be a Secretary of Science and Technology (hereinafter referred to as the "Secretary"), who shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at the rate provided by law for heads of the executive departments.

UNDER SECRETARY AND ASSISTANT SECRETARIES

SEC. 102. There shall be in the Department an Under Secretary of Science and Technology, such Assistant Secretaries as shall be determined by the President to be necessary, and a General Counsel, each of whom shall be appointed by the President, by and with the advice and consent of the Senate, shall perform such functions and duties as the Secretary may prescribe, and shall receive compensation at the rate provided by law for under secretaries (other than the Under Secretary of the Department of State), assistant secretaries, and general counsels, respectively, of the executive departments. The Under Secretary (or, during the absence or disability of the Under Secretary, or in the event of a vacancy in

the office of the Under Secretary, an Assistant Secretary determined according to such order as the Secretary shall prescribe) shall act as Secretary during the absence or disability of the Secretary or in the event of a vacancy in the office of Secretary.

PROVISIONS OF LAW APPLICABLE TO THE DEPARTMENT

SEC. 103. Except to the extent inconsistent with this Act, all provisions of law applicable to the executive departments generally shall apply to the Department.

SEAL

SEC. 104. The Secretary shall cause a seal of office to be made for the Department, of such design as the President shall approve, and judicial notice shall be taken thereof.

DELEGATION OF AUTHORITY

SEC. 105. The Secretary may, without being relieved of his responsibility therefor, and unless prohibited by some specific provision of law, perform any function vested in him through or with the aid of such officials or organizational entities of the Department as he may designate.

NATIONAL SCIENCE FOUNDATION

SEC. 106. The National Science Foundation, together with its personnel, property, records, obligations, commitments, and the unexpended balances of its appropriations, is transferred to the Department where it shall exercise its functions subject to the supervision and direction of the Secretary.

TRANSFERS FROM THE DEPARTMENT OF COMMERCE

SEC. 107. (a) (1) All functions of the Secretary of Commerce with respect to the Patent Office are transferred to the Secretary.

(2) The Patent Office is transferred to the Department.

(b) (1) All functions of the Secretary of Commerce being administered through the Office of Technical Services in the Department of Commerce (including functions under the Act entitled "An Act to provide for the dissemination of technological, scientific, and engineering information to American business and industry, and for other purposes," approved September 9, 1950 (64 Stat. 823)), and any other functions of such Office, are transferred to the Secretary.

(2) Functions transferred to the Secretary under the provisions of this subsection shall be administered through a component of the Department to be known as the Bureau of Technical Services.

(3) The Bureau of Technical Services shall have responsibility for: (a) The development of a complete science information program, utilizing all facilities of the Federal Government now vested in agencies which operate related programs; (b) to acquire, in cooperation with other public or private agencies, scientific literature, both from foreign and domestic sources; (c) to establish necessary facilities within the Bureau, or in other public or private agencies, to collate, declassify (subject to the requirements of section 5 of the Act of September 9, 1950 (64 Stat. 823)), translate, abstract, index, store, retrieve, and disseminate information essential to the development of scientific and technological programs as may be determined to be in the national interest and consistent with security requirements; and (d) to encourage the elimination of duplication of effort through the integration and coordination of functions vested in the Bureau and in other agencies: *Provided*, That the Bureau may supplement and support services provided by non-Government sources in the field of collecting, translating, or disseminating scientific information.

(4) The Bureau shall have the added responsibility for (a) the development and utilization of mechanical aids and new devices for collating, translating, abstracting, indexing, storage, and retrieval of scientific and technological information under the control of the Federal Government, and to coordinate such data as may be available from other sources; (b) to establish rules and regulations governing the distribution of publications as may be necessary to assure maximum utilization, including the assessment of such fees as may be deemed appropriate; and (c) to undertake through the facilities available to the Secretary, including educational or research institutions and private laboratories, the establishment of such additional services as may be required to further scientific, engineering, and technological research, and to aid in the development of inventions, discoveries, products, processes, and techniques.

(c) (1) The National Bureau of Standards is transferred to the Department and all functions of the Secretary of Commerce being administered through such Bureau are transferred to the Secretary.

(2) The Secretary shall establish a component of the Department separate from the National Bureau of Standards through which he shall administer the functions being carried out through the radio and cryogenic laboratories at Boulder, Colorado.

(d) All officers and other personnel, property, records, obligations, commitments, and unexpended balances of appropriations, allocations, and other funds, which the Director of the Bureau of the Budget determines are used primarily in relation to any office, bureau, or function transferred under the provisions of this section, are transferred to the Department.

ATOMIC ENERGY COMMISSION

SEC. 108. The Atomic Energy Commission, together with its personnel, property, records, obligations, commitments, and the unexpended balances of its appropriations, is transferred to the Department where it shall exercise its functions subject to the supervision and direction of the Secretary and shall be known as the Atomic Energy Administration of the Department of Science and Technology.

TRANSFERS FROM SMITHSONIAN INSTITUTION

SEC. 109. (a) The following functions of the Smithsonian Institution are transferred to the Secretary:

(1) All functions being administered through the Division of Astrophysical Research;

(2) All functions being administered through the Division of Radiation and Organisms;

(3) All functions transferred to such Institution under the provisions of part VIII of Reorganization Plan Numbered 3 of 1946 (relating to the Canal Zone Biological Area);

(4) All functions with respect to the exchange of scientific publications being administered through the International Exchange Service; and

(5) Any other functions of such Institution which are determined by the Director of the Bureau of the Budget to relate primarily to scientific research not related to museum or zoological purposes.

(*b*) All personnel, property, records, obligations, commitments, and unexpended balances of appropriations, allocations, and other funds, which the Director of the Bureau of the Budget determines are used primarily in relation to any function transferred under the provisions of this section, are transferred to the Department.

(c) Nothing in this section shall be deemed to authorize any transfer which in the opinion of the Attorney General cannot be made because of the provisions of a private bequest or other grant to such Institution.

TRANSFER MATTERS

SEC. 110. All laws relating to any agency or function transferred under this Act shall, insofar as such laws are not inapplicable, remain in full force and effect. Any transfer of personnel pursuant to this Act shall be without change in classification or compensation, except that this requirement shall not operate to prevent the adjustment of classification or compensation to conform to the duties to which such transferred personnel may be assigned. All orders, rules, regulations, permits, or other privileges made, issued, or granted by any agency or in connection with any functions transferred by this Act, and in effect at the time of the transfer, shall continue in effect to the same extent as if such transfer had not occurred, until modified, superseded, or repealed. No suit, action, or other proceeding lawfully commenced by or against any agency or any officer of the United States acting in his official capacity shall abate by reason of any transfer made pursuant to this Act, but the court, on motion or supplemental petition filed at any time within twelve months after such transfer takes effect, showing a necessity for a survival of such suit, action, or other proceeding to obtain a settlement of the questions involved, may allow the same to be maintained by or against the appropriate agency or officer of the United States.

EXPENDITURES AUTHORIZED

SEC. 111. The Secretary is authorized to make such expenditures (including expenditures for personal services and rent at the seat of government and elsewhere, for lawbooks, books of reference and periodicals, and for printing and binding) as may be necessary to carry out the provisions of this Act, and as may be provided for by the Congress from time to time.

REPORTS TO CONGRESS

SEC. 112. The Secretary shall make at the close of each fiscal year a report in writing to Congress giving an account of all moneys received and disbursed by him and the Department, describing the work done by the Department, and making such recommendations as he shall deem necessary for the effective performance of the duties and purposes of the Department.

AMENDMENT

SEC. 113. Section 158 of the Revised Statutes of the United States, as amended (5 U. S. C. 1), is amended by inserting at the end thereof the following:
"Eleventh: The Department of Science and Technology."

APPROPRIATIONS AUTHORIZED

SEC. 114. There are authorized to be appropriated such sums as may be necessary to enable the Department to carry out the provisions of this Act and to perform any other duties which may be imposed upon it by law.

EFFECTIVE DATE

SEC. 115. The provisions of this title shall be effective on the date of enactment of this Act except that sections 106 through 110 shall be effective after ninety days following such date of enactment.

TITLE II—NATIONAL INSTITUTES OF SCIENTIFIC RESEARCH

DECLARATION OF POLICY AND PURPOSE

SEC. 201. The Congress finds that there is an urgent need for a greatly expanded program of scientific research in the United States if this Nation is to maintain its position of world leadership. The Congress finds further that the national interest requires that the United States Government afford creative scientists in the United States the environment and advanced facilities most conducive to the conduct of scientific research, either by means of the establishment of research centers, or by making available the funds, incentive, and encouragement necessary to enable the establishment or support of such centers through nonprofit organizations outside the Federal Government. It is the purpose of this title to encourage the establishment and support of scientific research centers for the conduct of basic and applied scientific research, as the national interest may require, through making possible adequate financial support to attract the most talented, qualified, and creative scientists in the Nation.

RESEARCH INSTITUTES FOR BASIC RESEARCH

SEC. 202. The Secretary is hereby authorized to establish, or to support the establishment of, one or more research centers or institutes in each of the following fields: Mathematics; engineering; the physical sciences, to include but not limited to, physics, chemistry, astronomy, geophysics, oceanography, and meteorology; the biological sciences; and the social sciences. Such research centers or institutes shall be devoted primarily to the conduct of basic scientific research, and may be operated by the Department directly or through support to private, nongovernmental institutions or agencies.

RESEARCH INSTITUTES FOR APPLIED RESEARCH

SEC. 203. Whenever the Secretary finds that the national interest clearly requires the undertaking of certain types of applied scientific research and that sufficient economic incentive does not exist for the undertaking of such research by nongovernmental organizations without governmental support, he may establish research institutes or support such applied research. Such research

institutes may be operated either directly, or on a contract basis through nongovernmental organizations.

REQUIREMENT

SEC. 204. No scientific research center or institute established or supported pursuant to this title shall be of a profitmaking character; nor shall any such research center or institute be established under this title if it would duplicate existing research facilities which are available for performing such work.

ADMINISTRATION

SEC. 205. Each research center or institute established and operated by the Department pursuant to this title shall be under the direction of a director appointed by the Secretary, who shall receive compensation at a rate not in excess of that provided for the Under Secretary of the Department. Each such director may, in accordance with such policies as the Secretary shall from time to time prescribe, appoint and fix the compensation of two associate directors and such other personnel as may be necessary. Scientific and professional personnel may be appointed and compensated without regard to the civil-service laws and the Classification Act of 1949.

REPORTS BY DIRECTORS

SEC. 206. The directors of institutes established and operated by the Department pursuant to this title, shall report annually to the Secretary as to the research programs undertaken and planned within each such institute.

REPORTS BY SECRETARY

SEC. 207. The Secretary shall report annually to the Congress, for each preceding year, with respect to the research institutes established and supported, the nature of the programs undertaken, the cost of such programs, and the estimates of cost for each succeeding year.

TITLE III—SCHOLARSHIP LOANS

DEFINITIONS

SEC. 301. As used in this title—

(1) The term "Administrator" means the Administrator of Scientific and Technological Education, Department of Science and Technology;

(2) The term "Loan Director" means the Student Loan Director designated under this title;

(3) The term "State" means a State, Alaska, the Canal Zone, the District of Columbia, Hawaii, Puerto Rico, or the Virgin Islands;

(4) The term "institution of higher education" means a public or private nonprofit college or university; and

(5) The term "financial institution" means a financial or credit institution (including any insurance company) which is subject to examination and supervision by an agency of the United States or of any State.

ESTABLISHMENT OF LOAN AND LOAN INSURANCE PROGRAM

SEC. 302. (a) The Secretary shall establish a program providing for loans, and loan insurance, in accordance with the provisions of this title, for the purpose of encouraging and assisting individuals to obtain education beyond the secondary school level in the fields of the physical sciences, to include but not limited to, physics, chemistry, astronomy, geophysics, oceanography, and meteorology, the biological sciences, mathematics, or engineering. The Secretary may establish priorities for such loans or loan insurance for education in particular fields whenever he determines such priorities are in the national interest.

(b) The provisions of this title shall be administered by the Administrator under the direction of the Secretary.

(c) The Secretary may establish a Bureau of Student Loans under this title to be headed by a Loan Director responsible to the Administrator to assist in carrying out the provisions of this title.

(d) The Secretary may establish such rules and regulations as are necessary to carry out the provisions of this title. In establishing such rules and regulations and in carrying out such provisions the Secretary shall consult and cooperate with

State agencies primarily concerned with higher education and with established associations of privately endowed colleges and universities.

FEDERAL LOAN AND LOAN INSURANCE FUND

SEC. 303. (a) There is hereby established in the Treasury a special fund to be known as the "Federal Education Loan and Loan Insurance Fund", which shall be used as a revolving fund for making loans under this title and for loan insurance purposes under this title.

(b) There are authorized to be appropriated to the fund for direct loan purposes for the fiscal year beginning July 1, 1958, the sum of $40,000,000; for the fiscal year beginning July 1, 1959, the sum of $60,000,000; for the fiscal year beginning July 1, 1960, the sum of $80,000,000; for each of the fiscal years beginning July 1, 1961, 1962, 1963, and 1964, the sum of $100,000,000; and thereafter so much as shall be necessary to maintain the direct loan account in the revolving fund.

(c) There are authorized to be appropriated to the fund such amounts as are necessary for loan insurance purposes.

DISTRIBUTION AMONG STATES

SEC. 304. The Secretary shall provide for the distribution among the States of loans and loan insurance under the provisions of this title, in accordance with such formula as he determines from such information as may be reasonably available to him (1) to be best suited for the purposes of this title, and (2) to recognize the needs of each State based, among other criteria, on the number of students graduating from secondary schools, the number of young people in selected specific age categories between 17 and 21, the per capita income in such State, and the burden which the State is bearing in higher education through facilities, direct assistance, or otherwise.

DIRECT LOANS

SEC. 305. Loans made directly to individuals under the provisions of this title—

(1) shall be made in such numbers as may be possible with available funds;

(2) shall be made upon application in such form and containing such information as may be prescribed by the Secretary;

(3) shall be made only in cases where loans from private sources cannot be obtained on terms as favorable to the borrower; except, if study is to be made abroad this requirement need not be met;

(4) shall not exceed $1,500 for any academic year of education, and shall not be made for more than five such years of education, including post-graduate education at the discretion of the Secretary;

(5) shall be made only to individuals certified by an institution of higher education as acceptable for the course of study for which such loan is sought;

(6) shall be made without security; except that the borrower shall execute a promissory note payable to the United States, and if the borrower is a minor such note shall bear the endorsement of his or her parent or guardian;

(7) shall be due and repayable not later than ten years after the date on which the borrower ceases to pursue a full-time course of study at an institution of higher education on such terms as the Secretary may prescribe or as shall be approved by him: *Provided*, That the first installment of repayment shall commence not later than one year after ceasing full-time study or such sooner time as the student shall accept full-time compensated employment;

(8) shall bear interest at 2 per centum per annum or such higher rate as shall be fixed by the Secretary; but no interest shall accrue prior to the commencement period of repayment or one year after ceasing full-time study, whichever is sooner;

(9) may be made in such installments as the Secretary deems appropriate, and in the event made in such installments, may be discontinued at any time the borrower fails to maintain satisfactory proficiency in the course of study for which the loan is made.

(10) shall not be made to any individual for any period during which he is receiving benefits under part VIII of Veterans Regulation Numbered 1 (a), title II of the Veterans' Readjustment Assistance Act of 1952, the War Orphan's Educational Assistance Act of 1956, or any Federal scholarship; and

(11) shall be used only to defray the costs, while pursuing a full-time course of study in the fields of the physical or biological sciences, mathematics, or engineering, at an institution of higher education, of tuition, fees, books, supplies, board, lodging, and other expenses necessary to the education being received at such institution.

CANCELLATION AND PAYMENT OF LOANS

SEC. 306. The Secretary may provide for the cancellation or payment of any loan made or insured under the provisions of this title if the borrower, upon completion of his course of study accepts full-time employment in the Federal Government, or employment on any project or program designated by the Secretary in the fields of the physical or biological sciences, mathematics, or engineering. Such loans shall be canceled or paid at the rate of $1,500 for each year in which the borrower is employed in a full-time position in the physical or biological sciences, mathematics, or engineering, in any agency of the Federal Government or on any project or program designated by the Secretary and as long as the borrower is so employed all interest on his loan shall be canceled or paid.

LOAN INSURANCE

SEC. 307. Loan insurance provided for under this title—

(1) may be provided for loans not in excess of a cumulative total of $1,000,000,000: *Provided*, That the Secretary shall recommend to the Congress such upward limit as he deems advisable after the first seven full years of this program and periodically thereafter;

(2) shall provide for payment to financial institutions and institutions of higher education of 90 per centum of any losses suffered on loans;

(3) shall insure only loans meeting the requirements established for direct loans in clauses (4), (5), (7), (8), (9), (10), and (11) of section 405; provided that the Secretary shall make direct grants to financial institutions and institutions of higher education sufficient to cover the difference between the interest payable by the student over the period covered by the loan and the total interest which the institution receives or requires on similar loans;

(4) shall be without charge to the borrower or lender; and

(5) shall be subject to such additional terms, conditions, and requirements as the Secretary may determine to be necessary to protect the financial interests of the United States and to carry out the purposes of this title.

LIMITED SERVICE FEES

SEC. 308. Nothing in this title shall preclude an institution of higher education which loans money subject to insurance from charging a reasonable servicing charge under rules and regulations promulgated hereunder.

ACCEPTANCE OF GRANTS AND BEQUESTS

SEC. 309. The Secretary is authorized to accept gifts, grants, bequests, or devises for carrying out the purposes of this Act.

GRANTS TO STATES AND APPROPRIATIONS AUTHORIZED

SEC. 310. For the purpose of encouraging State assistance in facilitating the availability of loans to students in institutions of higher education engaged in a course of study in the fields of the physical or biological sciences, mathematics, or engineering, the Secretary is authorized to make direct grants of not more than $200,000 to any one State in any fiscal year which shall be kept in a separate fund under the control of the State agency charged with chief concern over institutions of higher education. Such funds shall be made available to help meet the organization and operating expenses of nonprofit corporations chartered for the principal purpose of providing loan programs for students of the State desiring to further their education beyond high school in the fields of the physical or biological sciences, mathematics, or engineering. There are authorized to be appropriated such amounts as may be necessary for the payments authorized in this section.

PROHIBITION OF FEDERAL CONTROL; AND ADMINISTRATION THROUGH STATE AGENCIES AND INSTITUTIONS

SEC. 311. (a) Nothing contained in this title shall be construed to authorize any department, agency, office or employee of the United States to exercise any direction, supervision, or control over the curriculum or program of instruction of any educational institution or over its administration or personnel.

(b) So far as practicable, the Secretary shall provide for administration of loans through and in conjunction with the nonprofit corporations referred to in

section 410, or when there is no such corporation, through the institution of higher education at which there are students participating in the program established by this title.

ADMINISTRATIVE APPROPRIATIONS AUTHORIZED

SEC. 312. There are authorized to be appropriated such amounts as may be necessary for the administration of this title.

TITLE IV—OVERSEAS PROGRAMS

AUTHORIZATION

SEC. 401. The Secretary is authorized to establish programs outside of the United States for collecting, collating, translating, abstracting, and disseminating scientific and technological information, and to conduct and support other scientific activities, including cooperative programs and projects between the United States and other countries. Notwithstanding section 1415 of the Supplemental Appropriation Act, 1953, or any other provision of law, the Secretary, in carrying out the provisions of this section, may, in cooperation with governmental and other agencies, use currencies, or credits for currencies, of any foreign government held or available for expenditure by the United States and not required by law or agreement with such government to be expended or used for any other purpose.

Senator HUMPHREY. At this point I present for the record a letter that I received under date of April 30 from the Librarian of Congress relating to this particular part of S. 3126. This letter is very helpful in terms of describing the work that the Library of Congress presently performs.

Mr. Mumford, Librarian of Congress, says:

What is, in effect, a National Library of Science already exists in the Library of Congress.

This sentence within itself describes the general content of the letter.

(The document referred to is as follows:)

WASHINGTON, D. C., *April 30, 1958.*

Hon. HUBERT H. HUMPHREY,
Chairman, Subcommittee on Reorganization, Committee on Government Operations, United States Senate, Washington, D. C.

DEAR SENATOR HUMPHREY: Although S. 3126 makes no mention of the Library of Congress and its scientific collections and activities, there are some features of the bill that, both directly and indirectly, will affect us. I will not ask for time to testify, but I would appreciate it if this letter could be introduced into the hearings on S. 3126.

What is, in effect, a national library of science already exists in the Library of Congress. Our collections include well over a million volumes in science and technology and most of the important periodicals in these fields published throughout the world. Collections of such breadth and depth as ours cannot be built up overnight. We have spent nearly a century—since 1866, when the Smithsonian Institution's fine science collection was transferred to the Library—in achieving and maintaining preeminence in the literature of science and technology, developing in the course of our efforts a worldwide network of exchange agreements and purchase arrangements.

Although S. 3126, section 107, subsection (b) (3) provides that the proposed Bureau of Technical Services of the Department of Science and Technology, in the development of "a complete science information program," shall utilize "all facilities of the Federal Government now vested in agencies which operate related programs," it also provides that the Bureau shall "acquire, in cooperation with other public or private agencies, scientific literature, both from foreign and domestic sources." Thus it seems evident that the intent is to build up a collection of scientific materials separate from that of the Library of Congress. I cannot help but view with alarm any move that might serve to fragment or otherwise weaken the national collections administered by the Library. I question whether a collection of strength can be acquired in time to be useful in the imme-

diate future by an agency so late in entering the field. I deplore the wasteful duplication of effort that would inevitably result, because the Library of Congress would have to continue acquiring scientific and technical books and periodicals in order to meet its increasing obligations for providing Congress with informational materials and impartial research studies in these fields.

The success of a centralized science information program will ultimately rest on the strength of the collections it has to exploit. Those of the Library of Congress in science and technology are second to none in the United States, and they enjoy, moreover, the outstanding advantage of being associated with distinguished collections of literature of other fields of thought and endeavor with which science must necessarily interact. A core program not only in assembling and organizing these scientific and technical materials but also in indexing and abstracting, is already underway in the Library. This is carried out through our Division of Science and Technology and through defense projects which we operate. Thus, in the Library of Congress we already have the nucleus of a national science information program. Is it proposed that our activities be dropped? If not, it is not clear to me what the machinery would be for the Bureau of Technical Services, in the executive branch of the Government, to bring about the "integration and coordination of functions vested in the Bureau and other agencies," specifically the Library of Congress in the legislative branch of the Government. I suggest that a fruitful course of action would be to strengthen and enlarge the Library's established program rather than embarking on a new one.

One other aspect of S. 3126 is of special concern to the Library. Section 109, subsection (a) (4) transfers to the proposed new Department of Science and Technology "all functions with respect to the exchange of scientific publications being administered through the International Exchange Service" of the Smithsonian Institution. In respect to this provision, I should like to point out that, even if it were possible to define specifically what is meant here by the term "scientific publications," it would be virtually impossible to separate the international exchange of scientific publications now being carried on among thousands of institutions and individuals throughout the world from the exchange of publications on other subjects. The fact that many serial publications cover both scientific and nonscientific subjects adds to the complications. For 92 years the Library of Congress has had the benefit of this exchange and it is not an exaggeration to say that it has been the backbone in the development of our preeminent collections. To attempt to separate the exchange of "scientific publications" from that of other materials would, I believe, only serve to set up duplicating systems, resulting in wasted effort and probably in the weakening of both systems.

In view of the foregoing I respectfully urge that the committee reconsider the provisions in section 107, subsection (b) (3) and (4), section 109, subsection (a) (4) in order that the development of a complete science information program will not unnecessarily duplicate or seriously restrict the collections and services that only a national library such as the Library of Congress can provide.

I enclose a statement on the Library of Congress as the National Library of Science, and I shall be happy to elaborate on it or on any of the statements in this letter if you so desire.

Sincerely yours,

L. QUINCY MUMFORD,
Librarian of Congress.

Senator HUMPHREY. I also have a statement from the Library of Congress entitled "The Library of Congress as the National Library of Science" which statement I found very illuminating, and I hope that it will be read by every member of the subcommitttee and members of the staff as well as those who are witnesses now, and prospective witnesses in the future.

(The statement referred to is as follows:)

THE LIBRARY OF CONGRESS AS THE NATIONAL LIBRARY OF SCIENCE

1. A distinguished library of science cannot be created overnight, even at great cost. It must be carefully built up over the years. Such is the science collection of the Library of Congress, which now numbers more than 1 million books and includes most of the important periodicals in science and technology published throughout the world.

2. The Library of Congress has been preeminent in science since 1866, when by act of Congress the Smithsonian Institution's "complete collection of the memoirs and transactions of learned societies throughout the world and an entire series of the most important scientific and library periodicals" were transferred to the Library of Congress in order that they might be housed and serviced more adequately.

3. The Library of Congress continued and greatly expanded the foreign exchange program begun by the Smithsonian. Today it has a worldwide network of more than 16,000 exchange agreements with foreign governments and private research centers, laboratories, universities, observatories, and other scientific and technical institutions, which brings in nearly half a million books, pamphlets, journals, and other materials annually in various fields, including science. The facilities of the Department of State, the United States Information Agency, and other United States agencies abroad are also utilized in adding to the collections. Through the operation of the copyright law, the Library receives all American publications and many foreign ones in the scientific field that are registered for copyright. Other materials are received through the operation of domestic exchange agreements and by transfer from other governmental agencies. Also, some 240 dealers throughout the world have standing orders to acquire publications of importance regardless of language or country of origin.

4. A very great measure of the Library's strength derives from its specializing against a background of general superiority. This interplay has enhanced its potential in science and technology. Its collections of Russian and Eastern European languages, for example, are the most extensive in the world outside the Soviet Union and the Iron Curtain countries, and this superiority applies to science materials as well as to the literature in other fields. In the fiscal year 1957, receipts through exchange and purchase from the U. S. S. R. alone in various subject fields, including science, totaled 81,514 pieces; 50,117 pieces came from 10 satellite countries through purchase only. A check of the Library's science receipts against Knizhnaia Letopis', the Soviet national bibliography, indicates that 60 percent of the Soviet materials currently published in the natural sciences and 41 percent of those published in technology are being obtained by the Library. Of the 930 Soviet periodicals (titles) issued in 1950–54, the Library received 501 or 54 percent. A similar strength obtains in the oriental language and other foreign language fields. The Library is also preeminent in the literature of aeronautics and of aeronautical science, and it is the best equipped library in the United States for geographic and cartographic research.

5. As the periodical article was the usual vehicle for disseminating scientific information in the 19th century, so the technical report has become the medium of today. The Library has in recent years accumulated many thousands of these reports, which emanate chiefly from American research, much of it sponsored by the United States Government and a high proportion of it related to military programs. Included are the technical reports issued by the Atomic Energy Commission, for example, and those distributed by the Office of Technical Services of the Department of Commerce and the Armed Services Technical Information Agency (ASTIA).

6. Through analysis, description, and the dissemination of information about its holdings in science and technology, as well as in other fields, the Library makes its national collections meaningful and available to the Government and the Nation: (*a*) Its systems of subject classification and subject headings, which are constantly being revised and kept up to date, are used by the major research libraries of the country, and the Library's experience in the development and application of these techniques to the organization and exploration of recorded information would constitute a great asset should the Library become the center of expanded activities in indexing, abstracting, and otherwise making more readily accessible specialized information. (*b*) The Library prints and distributes catalog cards describing not only its own holdings but those of many other libraries. The essential nature of this service is evidenced by the fact that there are nearly 10,000 subscribers to it. (*c*) The Library maintains the National Union Catalog, containing cards locating research materials in 700 North American libraries; and it publishes the National Union Catalog and other catalogs in book form. (*d*) To make information about acquisitions in certain fields, including science and technology, quickly available, the Library publishes the following monthly accessions lists: New Serial Titles, listing the periodicals received by the Library of Congress and some 200 other cooperating libraries, the Monthly List of Russian Accessions, the East European Accessions List, and the Southern Asia Accessions List. Out of a 1-year accumulation of 11,709 monographs included in the

Monthly List of Russian Accessions, 6,006 were classed as science and technology; of 8,918 periodical issues listed (not including newspapers), 4,800 were in the same fields. In 1 year (1956), the East European Accessions List described 1,522 monographs and 9,946 periodical issues in science and technology. In preparing these lists, the necessary translation for listing the subject content is done, but translation per se and the distribution of translations have not been normal functions of the Library.

7. These bibliographic endeavors make a formidable contribution to the Nation's scientific effort, but they do not begin to exhaust the Library's potential usefulness. It has also facilitated the widest possible exploitation of its resources, within the limits of budget, space, and its primary commitment of service to Congress. Since World War II, the Library has administered several large-scale projects on funds transferred from the Department of Defense ($3,218,863 in fiscal 1957) to provide analytical, abstracting, and bibliographic services on scientific and technical, including report literature, as well as other materials in the Library that need to be intensively utilized in undertakings important to the security of the United States and the free world. Although these projects required the development of new techniques and the performance of some operations outside the normal activities of a library, the Library of Congress undertook them because it had the basic bibliographic know-how, because it alone had the comprehensive collections necessary for effective exploitation, and because only in juxtaposition to those collections could these projects be carried on economically.

8. The focal point of subject competence within the Library in all fields of science and technology is the Science Division. Established in 1949, the Division, though small, now has an active bibliographic and reference program. It maintains, on a 7-days-a-week basis, a special science reading room, and its current bibliographic activities include a bibliography on the International Geophysical Year—a listing indexed on punched cards, of publications in all languages; a world list of aeronautical serials; and an accessions list of scientific and technical serials now being received by the Library. The Division also serves as a collecting and reference center for United States Government technical report literature, which is accumulating at an estimated rate of 20,000 reports a year; and it administers, under an Army contract, the snow, ice, and permafrost bibliography project. The increasingly important role played by the Division is demonstrated by the fact that four times as many reference services were performed in fiscal 1957 as in the previous year.

9. The Science Division needs to be greatly strengthened in order to meet the increasingly heavy demands for library services even of a traditional nature. The Library hopes to have the support of the Congress and the National Science Foundation in its requests for additional positions for this operation.

10. The foregoing brief examination of its resources, its services, and its potential should demonstrate that the Library of Congress is already, and for many years has been, the national library of science. The existence of a National Library of Medicine and a National Library of Agriculture (the library of the Department of Agriculture) does not argue for further fragmentation of the national collections. To the contrary, those two libraries were years in building, and the recognition of them as the national libraries in their fields was only acceptance of historic fact. Because a national library of science (with the exception of the fields of medicine and agriculture) already exists in the Library of Congress, because the Library has the best machinery for maintaining a vital flow of scientific and technical publications from all over the world, and because it has the necessary experience for exploiting these scientific and technical materials by traditional library methods and by the application of newer patterns established by its special defense projects, an effort to establish a separate national library of science would be wasteful, time consuming when time is of the essence, and not in the interest of the security of the country.

11. The stature of any library depends upon the adequacy of its response to the needs of its community. The Library of Congress feels that, if it is the will of Congress and if space can be obtained nearby, it can and should meet the present need of the Nation as a whole and of the scientific community in particular not only for an acceleration of traditional library services but for serving as a national information center in the fields of science and technology. This would entail not only a continuation of its present defense projects and possibly assumption of responsibility for the entire ASTIA operation (previously impossible because of lack of space), but also the establishment of centralized control over the large amount of translating that is being done, supplementing it as necessary, serving as a clearing house on research in progress, and otherwise disseminatng information

needed by the scientific community, both official and unofficial. For this work the Library has the basic collections and the supervising competence. It would need, of course, a greatly augmented staff of subject and language specialists. The Library, however, is the logical center for such expanded services. It already has a vast investment, perhaps the largest in the world, in the literature of science, and science, which in great measure relies for its own stimulation and growth on that literature, has an equally great stake in the Library of Congress.

Senator HUMPHREY. I also would like to ask Mr. Reynolds if he would include at the appropriate time in our record those letters and communications which may have been addressed to this committee, or this subcommittee, relating to S. 3126, and copies of the replies which have been submitted by the staff and by you, Mr. Reynolds, or by any other Senator who is a member of this subcommittee, if such Senator would care to have those letters made a part of the record.

Mr. REYNOLDS. I will see that that is done.

Senator HUMPHREY. Any memoranda or statement which may be developed by the staff should be made a part of this record.

We are very pleased to have such fine representation of the subcommittee here on such an important subject. I should say to Senator Lausche, this morning on Dave Garroway's show we heard a great deal about science from the governor's mansion in Ohio.

It was very good, excellent. There was General Medaris, and they had members of the industry and university circles, the president of the Ohio State University, and the Governor. It was a very fine conference relating to the need of scientists and scientific information. They demonstrated a great deal of self reliance, particularly as to the activities of the State in terms of developing programs of scientific advancement and improvement.

Our first witness today is Dr. Jesse H. Shera, dean of the School of Library Science, at Western Reserve University, Cleveland, Ohio.

If Dr. Shera would just come up here to the witness stand, and if he has any associates he would like to bring with him, he is entitled to do that, certainly.

Dr. SHERA. Thank you; I would like to bring up Mr. Perry and Mr. Kent.

Senator HUMPHREY. Dr. Shera, you are the gentleman who has the film?

Dr. SHERA. That is right.

Senator HUMPHREY. I should say to my colleagues that prior to their coming, I indicated that Dr. Shera had a film on this whole matter of scientific documentation and an operator and a machine here. I thought it would be well if you would see it as part of the testimony, if that is agreeable. Senator Lausche, I believe you had something?

Senator LAUSCHE. No; let them proceed.

STATEMENT OF JESSE H. SHERA, DEAN OF THE SCHOOL OF LIBRARY SCIENCE, WESTERN RESERVE UNIVERSITY, CLEVELAND, OHIO, ACCOMPANIED BY JAMES W. PERRY, DIRECTOR, CENTER FOR DOCUMENTATION AND COMMUNICATION RESEARCH, WESTERN RESERVE UNIVERSITY; AND ALLEN KENT, ASSOCIATE DIRECTOR, CENTER FOR DOCUMENTATION AND COMMUNICATION RESEARCH, WESTERN RESERVE UNIVERSITY

Dr. SHERA. Thank you, Senator, for this opportunity to talk to you about these problems which we feel are extremely serious and important at the present time, not to say critical.

Senator LAUSCHE. Mr. Chairman, might I say that I am pleased that Western Reserve, through its representatives, is present to offer the first testimony on this vital subject.

Several months ago, I received from Dr. Millis a document setting forth the advanced activity that Western Reserve University had taken on its own to collate scientific information for the general use in our country's approach to the problems confronting us, and I am glad to have them here as the initial witnesses.

Dr. SHERA. Thank you, Senator. This relieves me of some of my introduction.

I am very glad to be here, as I say.

We are not Johnnies-come-lately in this field. My associates, Mr. Perry, on my immediate right, is director of the Center for Documentation and Communication Research; and directly to his right is Mr. Kent, associate director. Both of these men have been working in this field since the late 1940's, first at the Massachusetts Institute of Technology, then at the Battelle Memorial Institute; and, fortunately for us, in Western Reserve—since 1955, with the school of library science at Western Reserve.

They have been exploring on operational and developmental levels areas which for some time I have been talking about, more or less on the policy level.

Let me give you just very briefly—and I hope this will not sound conceited. I do not mean it to be—but I do think I ought to express here my right to talk about these subjects.

I have been in this field since 1927, but let's skip over the first decade or so because it is not relevant.

In 1940, I went to the Library of Congress, in charge of a bibliographic center dealing with the problems of population. This was a joint agency set up in the Library of Congress, with the cooperation of the United States Bureau of Census.

In 1941, I joined the staff of what later became the Office of Strategic Services. When I joined, it was the Office of the Coordinator of Information. It was here that I saw the tremendous impact and importance of information to our Nation in the crisis that we faced, as you know, during the Second World War. On our ability to get necessary information to the Army, the Navy, the Air Force, to our allies, rested the national survival itself. And it was here that I had my first experience in beginning to explore the possibilities of mechanization of technical information.

We received material from the United States Office of Censorship, great quantities of it, which we put on IBM cards and organized.

So this was certainly one of the earliest attempts to use IBM technique to make information more readily available; because, as you know, time was then of the essence.

By 1950, I had gone to the University of Chicago, where I was conducting courses in this field, and conducting a couple of conferences which I will refer to in a moment.

In 1950 I was invited by the Department of State to serve as the United States representative to a UNESCO International Conference on the Improvement of Bibliographical Services throughout the world.

And I would like to submit as my first exhibit the digest of the report which I made on the coordination of information in the United States at that time.

(The exhibit referred to is as follows:)

EXHIBIT No. 1

THE PRESENT STATE OF BIBLIOGRAPHY IN THE UNITED STATES

A CONDENSATION OF THE UNITED STATES REPORT ON NATIONAL AND INTERNATIONAL BIBLIOGRAPHIC PROBLEMS [1]

(Jesse H. Shera and Margaret Egan)

Inasmuch as any discussion of planning for bibliographic development must take into account the various services already existing, a brief summary of such services would seem to be imperative.

CURRENT NATIONAL BIBLIOGRAPHY

Current national bibliography in the United States presents a complex and variegated pattern. This absence of coordination is apparent from even a brief enumeration of the major elements that comprise our current national bibliography:

1. The Catalog of Copyright Entries lists only those materials submitted for copyright. Furthermore the arrangement of the Catalog makes it completely unusable for most bibliographic purposes.

2. The United States Catalog of Books in Print, and its current supplement, The Cumulative Book Index, is largely restricted to the output of the major publishing houses, ignores the great bulk of pamphlet and ephemeral materials, but includes a certain number of English language publications issued elsewhere in the world.

3. The Publishers' Trade-List Annual is entirely restricted to the work of the major publishers, arranged by publisher, through it has recently added an author index to the whole. Similarly the listings in Publishers' Weekly are useful, but far from complete, and are not cumulated.

4. A very limited number of pamphlet materials are listed in the Vertical File Service of the H. W. Wilson Co., as well as in Publishers' Weekly.

5. The printed cards and the author and subject catalogs of the Library of Congress are, of course, restricted largely to materials acquired by that library and include much more than United States imprints.

6. The United States Government Publications Monthly Catalog is now fairly adequate with respect to the listing of Federal publications, with an annual subject index. State publications, however, are most inadequately listed in the Monthly Checklist of State Publications, while publications of political units smaller than States are not listed in any single source.

7. Doctoral Dissertations Accepted by American Universities, 1933–34, lists a type of material not included in any of the other lists unless it is published or copyrighted, but it includes no unpublished research other than doctoral dissertations.

[1] Presented at the UNESCO Conference, held in Paris in November 1950, on the improvement of bibliographical services. This report was prepared in response to a request from UNESCO that ALA furnish a statement concerning the present state of bibliographic services within the United States, together with proposals for improvement at both the national and international level. Dr. Shera, chairman of the ALA Committee on Bibliography, attended the UNESCO Conference as a United States delegate and presented the report which he had prepared in collaboration with Miss Egan. Both Dr. Shera and Miss Egan are on the faculty of the University of Chicago Graduate Library School.

8. Ayer & Son's Directory of Newspapers and Periodicals, published annually, is designed primarily as a guide to advertisers and is far from complete, omitting entirely such materials as house organs and labor union publications, which are seldom listed anywhere except in special bibliographies. Births and Deaths in the Periodical World, published three times a year in the Bulletin of Bibliography records changes in title, publication schedule, etc., as well as births and deaths, and attempts to cover all types of journals. There is no complete list of professional or scholarly journals.

9. There is no comprehensive listing of audiovisual materials and other types of nonbook materials.

Obviously, these lists contain many duplicating entries, without giving anything like complete coverage to national production.

RETROSPECTIVE BIBLIOGRAPHY

Restropective bibliography in the United States is far from complete or well organized, though it is probably better than that for most countries of the world. The most urgent bibliographic problem in the United States, however, is not one of catching up with the past, but of keeping up with the present.

CURRENT SUBJECT BIBLIOGRAPHY

Subject bibliography in the United States has become so profuse, as well as diffuse, that for more than a decade the H. W. Wilson Co. has published the Bibliographic Index, a quarterly guide cumulated annually, which last year indexed more than 3,000 bibliographies. These bibliographies appear in many forms and in many media, of which the most important for our purposes here are the current indexes and abstracting services published as separates.

The best known current indexes are Public Affairs Information Service and the various indexes of the H. W. Wilson Co. These indexes are designed primarily for the use of the general public and the practitioner of various applied arts and sciences; the literature covered includes very few foreign items and is almost exclusively popular, semipopular and vocational in nature.

Abstracting services are restricted largely to scholarly materials and age usually published by scholarly or professional associations. Outstanding examples of those published as separate, continuing services are: Chemical Abstracts, Psychological Abstracts, and Population Index. The largest number of bibliographic services to scholars, however, are buried as sections of journals, and are seldom cumulated. These services are useful chiefly for immediate browsing and are not at all convenient for extensive retrospective searching, while the exact opposite is true of the comprehensive indexing services.

Some of the best comprehensive subject bibliographies in this country have been produced by special subject libraries of the Federal Government, such as the Department of Agriculture Library and the library of the Surgeon General's Office.

To sum up, bibliographic services of different kinds are needed at each use level. In spite of the proliferation of subject bibliographies produced by private, institutional, commercial, associational and governmental agencies, the national picture is still characterized by a dismaying number of gaps as well as by expensive duplications. The number of vested interests involved in the production of these bibliographies will make coordination extremely difficult to achieve at this stage of development.

The bibliographic problems of the United States are further complicated by the existence of a number of organizations, societies, and institutions which have concerned themselves with bibliographic planning whether or not they themselves are extensive producers of bibliographies. As yet, no single agency has been able to assume a position of leadership in the field, or to coordinate effectively its own activities with the efforts of others. At the present time, then, there is no one place to which those interested in bibliographic development can look for direction or guidance.

SUGGESTIONS FOR A NATIONAL PROGRAM

Even this brief listing of the major elements that constitute the general pattern of bibliography in the United States is sufficient to indicate that the next steps in the direction of improvement do not relate to the establishment of a single new service or even a cluster of new services, but rather that the immediate concern is to promote cooperation among the many divergent but interested groups

whose bibliographic activities and interests are already established and to lay the groundwork for the future development of a more rational and less duplicative system. This implies a slow but well-planned advance based upon more certain knowledge than we now possess.

NEED FOR CENTRAL ORGANIZATION

Organization of central agency

The formation of a central bibliographic agency is proposed, with the following suggested characteristics:

1. Representation from all the organizations currently interested in bibliography.
2. A small executive council chosen from the larger body.
3. Financial support adequate to maintain a permanent headquarters with professional staff.

The logical body to assume the initiative in creating such a national agency is the American Documentation Institute, which is the United States affiliate of the International Federation for Documentation. In fact, the institute might well be reconstituted to be this agency. Membership should be of two kinds, both institutional and individual. Among the organizations whose support should be most earnestly solicited are library associations, other scholarly and professional organizations, research libraries and agencies, library schools offering research programs at the doctoral level, and commercial agencies.

Functions of central agency

1. To serve as a clearinghouse of information about bibliographic developments in the United States.
2. To offer expert consulting service about bibliographic problems and projects.
3. To publish a journal which would disseminate information about bibliographic activities and report results of research in the field.
4. To promote research through assistance in planning and coordinating research projects.
5. To promote experimentation in bibliographic coordination and techniques.
6. To promote education in the skills of bibliography through both formal training and internship, for both foreign and United States students.
7. To plan coordinated development of service to fields now unserved.
8. To assist in securing funds for any approved program.
9. To serve as liaison agency with international agencies and to make known abroad the results of research and experimentation in this country.

Need for research and experimentation

While it is no part of our function here to lay out a complete program of research or experimentation, a few suggested projects may indicate the nature of the problems to be solved.

Studies of use.—Studies of the use of scholarly or informational materials are needed for every group at every level.

Studies of types of bibliographies.—We need a taxonomy of bibliography based upon exact knowledge of the properties of bibliographies and the correlation of such properties with use-habits.

Surveys of existing particular bibliographies.—Orderly estimates of the extent of duplication and of the number of unfilled bibliographic needs depend upon surveys of the number and adequacy of bibliographic services in each field, with particular attention to relationships between fields.

Studies of physical accessibility.—(1) Tools for locating copies and possibilities for integrating subject and location services; (2) Studies of reproduction and transmission facilities such as microcards, photostat, teletype, etc.; (3) Studies of integration of library agencies, such as the proposed Illinois survey.

Experimentation with mechanical and electronic devices for bibliographic purposes.—One immediately practicable and useful project might be a study of the effectiveness of such a device as the Shaw Rapid Selector in manipulating a variety of abstracts drawn from various existing services. An experimental approach to classification might be carried out at the same time by classifying the same abstracts according to two or more systems. From this experiment might emerge a second directed toward the integration of the original production of two or more bibliographies, probably chosen from among those produced by agencies of the Federal Government. From this might grow the nucleus of a centralized bibliographic production agency, which might gradually draw in more and more of those services now separately produced and permit publication in more rationally planned units than is now the case.

Research in classification.—In addition to experimentation with existing systems, research is needed in the theoretical principles of classification and in the possibility of such new approaches as those suggested by Taube and Shera (15th Annual Conference, Graduate Library School, University of Chicago, 1950).

The research and experimentation programs which might be promoted with the aid of a central bibliographic agency have been spelled out here in some detail inasmuch as some of the projects are now underway or might be initiated in the near future by one or more of the constituent bodies.

SUGGESTIONS FOR AN INTERNATIONAL PROGRAM

There are several major areas in which international bibliographic organization can be effective:

1. Assistance to those countries in which bibliographic activity is still quite limited and in which the errors of unplanned development may still be prevented if the experience of more "advanced" countries is available at an early stage.
2. Aid to all countries by the provision of information concerning bibliographic developments throughout the entire world.
3. Stimulation of international bibliographic cooperation through the sponsorship of international bibliographic conferences and the exchange of personnel engaged in the study of bibliographic problems, methods, techniques.
4. Promotion of national subject bibliography as a means to the end of international subject bibliography in those fields where the international exchange of information is important.

INTERNATIONAL FUNCTIONS

More specifically the functions of an international agency might be suggested as follows:

A. Serve as a clearinghouse for information concerning bibliography.

B. Sponsor publication of (1) Unesco Bulletin for Libraries as a publication medium for bibliographic news, including abstracts of research reports on bibliographic problems from all countries; (2) an Index Bibliographious based upon national surveys, arranged by subject; (3) codified rules for bibliographic description and entry; (4) manuals for bibliographic procedures and for the management of bibliographic centers for such countries as wish to follow such standardized instructions; (5) directories of such agencies as bibliographic centers, libraries, publishers, bookdealers, learned societies (divided by subject where appropriate).

C. Sponsor international meetings on particular problems of bibliography.

D. Sponsor program for training in bibliographic skills through (1) a consultant service on world or regional basis available to any country or national agency which feels the need of such service; (2) international scholarships for study in accredited institutions or for internships in established bibliographic centers.

E. Sponsor and report research on all phases of bibliographic problems.

F. Encourage long-range planning of bibliographic development.

G. Coordinate development of libraries with development of bibliography.

DESIRABLE CHARACTERISTICS OF INTERNATIONAL AGENCY

The central body should be composed of representatives from each participating nation, serving for a definite term (expiration rotating), with a smaller council chosen from the larger body and vested with interim powers. Committees to work on particular problems may be appointed from within or without the membership.

The permanent working staff should be composed of salaried experts in the various fields with necessary clerical help. Field offices should be established when and wherever necessary.

The national agent of the international agency should be an established association or institution capable of assuring success of the program within its own country. This should be a requisite factor in continuing membership. Each government should be responsible for naming the agent within its own country (joint agencies would be possible, *i. e.*, a professional association with a national library, etc.)

Dr. SHERA. I think you will see, when you compare that with some of the things that we will bring out later, a rather striking parallel.

I was handicapped very seriously at that time because there was no Federal agency which could bring all this activity to a focus. So, it really came to naught.

We have in the United States, I think, a very curious situation:

The Library of Congress serves as our national library, but, actually, it is not the national library. It is exactly what its name implies; it is the Library of Congress.

We have no central national library as France does with the Bibliotheque Nationale now. It also has its Library of the Chamber of Deputies, which is comparable to our Library of Congress—so far as its legal position is concerned. The British Museum, of course, has nothing to do with the Library of the Houses of Parliament.

So that there was no single agency to which my report could be submitted. Of course it went to the Department of State, but they were in no position to do anything about it, had no legal responsibility for it. So nothing every came of it.

This was a source of great embarrassment to the United States because other countries had set up central information systems, even some of those we might call the underprivileged countries had gone much further than we in developing a coordinated information system. Now in a sense, of course, they had a much easier task than we because for them the idea was just getting started. They did not have to work around organizations that were already going and consolidate existing organizations.

Nevertheless, it was very embarrassing to me, representing the United States who was also supposed to be a leader in this field, to have to admit that there was no agency in the United States to which I could turn.

There have been held a number of conferences on this subject during the past 8 years. One was held at the University of Illinois in 1950 on Bibliography in an Age of Science. Another was held in the University of Chicago in 1950 on Bibliographic Organization, covering much the same field. Another one was held at Columbia University in 1952 on Subject Analysis of Library Materials, which also dealt with this same problem. A second one was held at the University of Chicago in 1952 on The Communication of Scientific Information. In 1956 we held a conference at Western Reserve on The Practical Utilization of Recorded Knowledge. The proceedings, by the way, of all of these have been published.

We held a second in April of 1957 on Information Systems in Documentation. Just this last March the Research and Development Command of the United States Air Force sponsored a conference here in Washington on documentation theory, and there is an international conference coming up this fall.

So you see, we are well taken care of with respect to conferences. We have plowed this ground over, and over, and over again, and I cannot believe that we are now at the stage where it will profit much from any further cultivation. This does not mean that we do not need research. We need a great deal of research, a great deal of fundamental basic research in this field. But I think the proliferation of conferences has gone on long enough. I think we know what needs to be done. The problem now is to do it, and this, over the past few years, has presented a very frustrating experience.

I assume the reason we are here is itself testimony to the fact that we consider this problem crucial at the present time. It has been brought to a focus by the Russian satellites. I am not saying the satellites were a blessing in disguise. If they were, certainly it was as Churchill said of the Battle of Britain, "If it was a blessing in disguise the disguise was perfect." But I do think that it was good that Russian scientific development was brought so very forcefully to our attention because I think nothing has so shattered our complacency in this country. And believe me, we have been complacent in this field. There is no question about it, we have been terribly complacent.

I would like to put into the record some further evidence. I have here a statement, which I believe has already been distributed to the committee, on the activities of the Soviet Union processing and disseminating scientific information. I think I need to say only briefly here that they do have an Institute of Science in Moscow which has attached to it a scientific information center. This is a huge monolithic structure which is doing a superb job, I gather from all the evidence we can get, in disseminating scientific and technical information throughout Russia. They are abstracting, they are translating, they are organizing, by mechanized methods, the total scientific literature of the world. And the scientists in this country who have had the opportunity to visit and examine these operations have been, well, to put it mildly, astonished by what they saw. They are getting ahead of us in this field, there is no question about this.

Senator HUMPHREY. Dr. Shera, at this point we will include in the testimony, and not in our files but actually in the testimony, that report on the Soviet activities in this field.

Dr. SHERA. Very good.

Senator LAUSCHE. How is that exhibit marked? I have exhibits marked "1, 2, 3"——

Senator HUMPHREY. Exhibit No. 2.

Dr. SHERA. I will give the numbers after this. I am sorry, I should have done this sooner.

(The exhibit referred to is as follows:)

EXHIBIT NO. 2

U. S. S. R. STATEMENT CONCERNING FEASIBILITY OF NEW MECHANIZED INFORMATION CENTER TECHNIQUES

In a U. S. S. R. publication: V. P. Cherenin, "Certain Problems of Documentation and Mechanization of Information Search" (Moscow, 1955), the work of the Western Reserve University group in mechanized information retrieval and correlation was discussed, with a report that the methods would be applied in at least one scientific field. In the same report, the following comment was made from the Soviet All-Union Institute of Scientific Information.:

"All this leads to the thought that the time is not far when a new revolution will occur in the storage and dissemination of data, similar to that which was produced by the invention of printing. It is difficult to guess how it will occur: nevertheless, by letting our imagination roam, it is possible to visualize the following information service of the future.

All arriving and all existing data, after the necessary editorial processing and suitable exterior styling, are photographed at a considerably reduced scale on photographic film. Instead of large runs, only several copies of such microfilm are produced and are sent to one or several information centers. These centers transmit continuously over many waves all the data available in them at a tremendous sequence frequency of frames of microfilm, reaching, for example, a million per second. With such a transmission speed all data accumulated by humanity can be transmitted over many waves within a comparatively brief time

interval—something like several minutes. The scanning of the microfilm in front of the receiving equipment of the transmitter can be accomplished in this case without excessive wear, for example, by using a rotating drum. Any frame of the microfilm can be received in any place on a special television screen equipped with a selecting device. The screen should hold the image on the frame for the required time and then should be ready for a new reception, that is, it should play the role of a longtime multiple use photographic plate. The selecting device—which acts in synchronism with the scanning of the microfilm—permits the image to fall on the screen either depending on the prescribed number of frames or depending on the inquiry code used to search the data coinciding with a code representing the contents of the data recorded in that frame. The latter possibility would be particularly valuable, for it would permit simultaneous selection of the problem of dissemination and of the problem of rapid retrieval of the necessary data, as discussed below. All the instructions, classification schemes, table of contents of the microfilm with indication of the number of frames, and code designations required for the use of such a televiser are transmitted at the start of the microfilm, therefore eliminating the need for using any kind of printed information.

It is difficult to overestimate the flexibility and effectiveness of such an imaginary method of storing and disseminating data. Undoubtedly such a method or something analogous to it will turn out to be cheaper than the existing methods, when the volume of data will reach a definite limit. It goes without saying that, just as after the appearance of printing the handwritten form of recording still remained in use, the appearance of a similar information service will still find a part of the data stored as before and disseminated in the form presently in existence. Let us remark in conclusion that, in spite of the fact that the information service of the future described above is quite fantastic, all the technical units required for its realization are in existence at the present time and are being constantly improved.

In later reports the increasing emphasis on scientific information exploitation in the U. S. S. R. has become more and more obvious.

Dr. SHERA. The third exhibit is a statement—and I do not think I will read it as we are pressed for time and you are busy. It is simply a paragraph statement from one of the Russian reports by Cherenin on certain problems of documentation and mechanization of information search, in which it simply states that Perry and his associates have been doing important work in this field of mechanization and the Russians are picking it up and going on with it. We do not know, of course, what they are doing, but I must say it is a little startling to pick up a Russian document on this subject and find the work of your own organization listed there.

Senator HUMPHREY. That is exhibit No. 3. That will also be made a part of the testimony.

Dr. SHERA. Thank you.

(The exhibit referred to is as follows:)

EXHIBIT No. 3

STATEMENT CONCERNING USE OF WESTERN RESERVE UNIVERSITY TECHNIQUES IN U. S. S. R. DOCUMENTATION RESEARCH

From V. P. Cherenin, Certain Problems of Documentation and Mechanization of Information Search, Moscow, 1955:

"* * * under the leadership of J. W. Perry there were collected some 30,000 (scientific) terms, which were then (analyzed) as to materials, processes, machines, qualities, derived concepts, etc. Several thousand of the terms were already analyzed with the aid of several hundred exhibited fundamental characteristics. To mechanize the search for the connection between terms, punched cards were used. The possibilities of employing such a procedure for the development of information language in the field of mechanics are being investigated in the Institute of Scientific Information of the Academy of Sciences, U. S. S. R."

Dr. SHERA. Exhibit No. 4 is one of the best, if not the best, statement I have yet seen in print. It appeared in the Federal Bar Journal for July–September 1957, and is entitled "The Dissemination of

Technical, Scientific, and Engineering Information as a Factor in 'Competitive Coexistence,' " by Jennie and Herschel Clesner.

Mr. REYNOLDS. Mr. Chairman, may I observe there I have furnished copies of that article to all members of this committee.

Dr. SHERA. Very good.

Senator HUMPHREY. We will include that particular article as a part of the testimony. I want this record to be rather complete on the subject.

Dr. SHERA. Very well.

(The exhibit referred to is as follows:)

EXHIBIT No. 4

THE DISSEMINATION OF TECHNICAL, SCIENTIFIC, AND ENGINEERING INFORMATION AS A FACTOR IN "COMPETITIVE COEXISTENCE"

(Jennie and Herschel Clesner [1])

I

In 1950, a Soviet scientist, A. G. Lunts, published a paper in a Journal of the U. S. S. R. Academy of Science dealing with the application of Boolean algebra, or symbolic logic, to the design of relay contact circuits in computers used in modern machines and weapons. The journal was readily available in this country, but from 1950 to 1955 scientists of the various American computer manufacturers attempted to do the same work over again because they didn't know the paper existed. They wasted 5 fruitless years and large amounts of research money before someone discovered the publication.[2]

This story is not an isolated incident.[3] The situation probably will be repeated many times in the days to come for a great flood of Soviet scientific publications are coming into this country due to the improved availability and the increased output of Soviet scientific research.[4] The vast bulk of this material collects dust on the Library of Congress shelves and elsewhere.[5]

For the most part the Soviet documents have not been translated, so the average United States scientist and businessman are unaware of their existence.[6] As a result, it is not possible for United States industry to take advantage of Soviet techniques and knowledge as described in Soviet publications.

In contrast, Soviet industry and scientists receive greater benefit from our research and that of the rest of the world than we do, for we do not index, classify, abstract, and promptly disseminate our own unclassified scientific and technical material—let alone the rest of the world's—to the extent and thoroughness of the Soviet All Union Institute of Scientific and Technical Information.

We do not adequately make available to the public, unclassified scientific and technical reports developed with public funds. Furthermore, we do not have a central organization trained to review classified scientific and technical information developed with public funds to determine whether a recommendation should

[1] Opinions expressed are personal and do not purport to reflect the views of the Senate Committee on Judiciary's Subcommittee on Patents, Trademarks, and Copyrights.

[2] W. N. Locke. Translation by Machine, January 1956, Scientific American, November 1, 29, 1956. Gerald Piel, publisher, Scientific American. Hearings, Availability of Information From Federal Executive Agencies, pt. 4—Panel discussion on scientific and technical information before U. S. House of Representatives Committee on Government Operations Subcommittee on Government Information, 84th Cong., 2d sess., March 1956, pp. 872-876.

[3] National Science Foundation in its last report to the Congress stated that "several cases have come to light in which, due to the language barrier, American scientific and engineering progress has been retarded by our lack of knowledge of research and development already completed by the Soviet scientists * * * the development and perfected by the Russians of a turbodrill for speeding the drilling of oil wells. This development was published by the Russians in their own literature 6 or 7 years ago, but was not known to our engineers until recently because of the problem of translation and the lack of operating facilities for abstracting and distributing such information. There have been other cases where valuable time was lost because we were duplicating work Soviet scientists had already completed." Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations—National Science Foundation, 85th Cong., 1st sess., February 1957, p. 1387. For the several instances that are known there are countless others which will never be known.

[4] Hearings, Independent Office Appropriations for 1958, before U. S. House of Representatives, Committee on Appropriations Subcommittee on National Science Foundation, 85th Cong., 1st sess., p. 1390; Robert Coll., U. S. Held Blind to Red Science, Washington Post and Times Herald, August 5, 1957, p. A-9.

[5] Hearings, ibid, p. 1389. Coll, loc. cit.

[6] Robert Coll, U S. Held Blind to Red Science, Washington Post and Times Herald, August 5, 1957, p. A-9.

be made to release it. As a result, United States industry and science is wasting essential time and money to rediscover known facts.[7]

The Soviets, by actually establishing a clearinghouse to disseminate the scientific and technical ideas from the rest of the world to their own scientists, are able to place at the disposal of their industry worldwide techniques. For several years we have had laws on the books directing the establishment of a coordinated central clearing house of scientific information.[8] However, none has been established; as a result, our industry, engineers and scientists suffer. Our need for a real coordinated central clearing house to obtain, translate, abstract and disseminate the world's scientific and technical information to our industry, scientists and engineers never has been more urgent. If we do not act, the Soviet aim to overtake us as the most productive economic nation in the world through technological world leadership will be no idle boast.[9]

II

The U. S. S. R. has long embarked on a crash program to become the world's leading scientific and technological power. Motivated by the specific desire to wrest world scientific, technological, industrial, and economic control from the United States, the Soviets are attempting to achieve this goal by a mass attack on all fronts. Since World War II the U. S. S. R. has placed an A–1 priority on science. The Academy of Scientists of the U. S. S. R. is held responsible for the planning of the Soviet scientific program.[10] The primary steps have been to strengthen their nationwide scientific apparatus and to increase the number and quality of their scientists and engineers. Scientific advance is dependent on the number and quality of trained scientists, engineers, and technicians and their continued success in pushing back the boundaries of the unknown through basic and applied research.

The Soviets have established a remarkable system of incentives for scientists and engineers in order to increase their numbers and quality. Their rates of compensation are designed to provide this class with excess purchasing power.[11] The rates of compensation for scientists and engineers exceed that of doctors, lawyers, and other groups.[12] The more distinguished scientists and engineers are awarded some of the highest administrative positions in the Soviet Union,[13] summer and/or winter homes,[14] honorary state awards,[15] chauffeur-driven cars [16] and a social position equal to the highest party leaders.[17] The Soviet scientists are freer than most from the restraints of party and police doctrine.[18] The Soviet state also insures that after the death of the scientist his immediate family will be provided for. Students who qualify for scientific and technical universities are subsidized at a variable stipend which averages more than the average Soviet industrial worker receives in pay.[19] This stipend varies as to the individual's class standing and academic honors.[20] Only the cream of the students of the Soviet school system can qualify for scientific work.[21]

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[7] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation, 85th Cong., 1st sess., p. 1387.

[8] 15 U. S. C. 1151–1157 and 42 U. S. C. 1862, 1870.

[9] Dr. Harry Schwartz, Khrushchev's Purge and our Grandchildren, New York Times magazine section, July 14, 1957, p. 5.

[10] Dr. Irving Langmuir, codirector, General Electric Research Laboratories. Hearings, Science Legislation, before U. S. Senate Committee on Military Affairs Subcommittee on War Mobilization, 79th Cong., 1st sess., October 1945, p. 31.

[11] Ibid, p. 30.

[12] How Good Is Soviet Science, Fortune, February 1957, vol. LV, No. 2, pp. 118, 119, and 194; Howard Simons, Russian Science Today, Science News Letter, December 1, 1956, p. 339; Dr. Irving Langmuir, hearings, Science Legislation, before U. S. Senate Committee on Military Affairs Subcommittee on War Mobilization, 79th Cong., 1st sess., October 1945, p. 30; Dr. Robert Wilson, Scientific Research in the Soviet Union, proceedings of symposium on industrial research at 61st Congress of American Industry, Waldorf-Astoria Hotel, National Association of Manufacturers, December 7, 1956.

[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Ibid.

[18] Dr. Robert Wilson, Scientific Research in the Soviet Union, proceedings of symposium on industrial research at 61st Congress of American Industry, National Association of Manufacturers, December 7, 1956. How Good Is Soviet Science, Fortune, February 1957, vol. LV, No. 2, pp. 118, 119, and 194; Howard Simons, Russian Science Today, Science News Letter, December 1, 1956, p. 339; Charles Quattlebaum, Development of Scientific Engineering, and Other Professional Manpower, Senate Committee on Government Operations print, 85th Cong., 1st sess., April 1957, p. 12.

[19] How Good is Soviet Science, Fortune, February 1957, vol. LV, No. 2, p. 120; Howard Simons, Big Man on a Red Campus, Saturday Evening Post, vol. 229, No. 47, May 25, 1957, pp. 37, 151–154.

[20] Ibid.

[21] Ibid.

Each year the U. S. S. R. is graduating more engineers and scientists than is the United States.[22] Some authorities state that the Soviets have already surpassed us in the total number of graduate scientists and engineers working at their professsion.[23] Their output will continue to increase at a much greater rate than our own, for the number of our university students majoring in engineering and science has decreased while the number in the Soviet Union continues to increase at a rapid rate.[24]

Admitting the loss of the battle as to the number of scientists and engineers, our policy allegedly is to maintain a higher quality of trained scientists and engineers.[25] Quality, however, is determined by the achievement of the average scientist and engineer. Background, training, facilities, and the availability of information are necessary tools which the scientist and engineer must have. A scientist given a research problem turns first to the communication media available to determine what has been done in the past and what is being done now in the area of his problem. It is even probable that others may have found the answer to his problem. It is a waste of time and money to have people rediscover known facts. World history is filled with many instances where inadequate information and communication among scientists have created harmful delays in scientific advance.[26] The communication of information is a vital part in the growth and development of scientific and technological research.

Recognizing that communication media are an essential and vital part of scientific and technological research and development, the Academy of Science of the U. S. S. R. in 1952 established the All Union Institute of Scientific and Technical Information in Moscow. The institute now has a permanent staff of 2,300 translators, abstractors, and publishers.[27] This staff is supplemented by more than 20,000 cooperating professional scientists and engineers throughout the U. S. S. R. who act as part time translators and abstractors in their specialized fields.[28] The institute publishes 13 abstract journals which annually contain over 400,000 abstracts culled from more than 10,000 journals originating in more than 80 countries.[29] The Soviet All Union Institute of Scientific and Technical

[22] How Good is Soviet Science, Fortune, February 1957, vol. LV, No. 2, p. 120; Willard Libby, Commissioner, U. S. Atomic Energy Commission, Education and Peaceful Atom, Department of State Bulletin, September 17, 1956, pp. 445-451.

[23] Howard Simons, Russian Science Today, Science News Letter, December 1, 1956, pp. 339-340; Eliot Tozer, What the Engineering Shortage Means, Aviation Age, July 1956, p. 20; Harris Collingwood, Engineering and Scientific Manpower in the United States, Western Europe, and Soviet Russia, prepared in the Legislative Reference Service for use of the Joint Committee on Atomic Energy, 84th Cong., 2d sess., Joint Committee print, March 1956.

[24] How Good is Soviet Science, Fortune, February 1957, vol. LV, No. 2, p. 120; hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, 85th Cong., 1st sess., p. 1296; Comparison Between United States and U. S. S. R. Scientific Personnel, National Science Foundation Report, August 3, 1956; Adm. H. G. Rickover, The Situation in American Engineering and Scientific Education, School and Society, May 26, 1956, p. 176.

[25] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, 85th Cong., 1st sess., pp. 1277 and 1292.

[26] Examples: Antibiotic properties of the mold penicillin was reported in 1896 in an Italian journal and was finally rediscovered over 30 years later by Sir Alexander Fleming. The use of an extract of the plant, Rauwolfia, as a tranquilizing drug was reported in a book on native African medicine but it took another 10 years to rediscover its use. The effect of 2, 4-D plant foliage was known and published but for 20 years did not come to the attention of those who could develop this use. Prof. Willard Gibbs of Yale University in 1848 published an article on the "phase rule" detailing the manner in which the physical states of elements are affected by varying conditions of temperature, pressure, and concentration. Forty years later the German chemist, Ostwald, noted it and translated it in German. Americans were to learn of this basic American discovery only from the German application of this principle to alloys. In 1939 W. H. Bennett discovered a device for improving the output of the electrostatic generator, an atom smasher. This device makes the atomic particle to move twice as fast as it ought to. Fifteen years later this device was rediscovered and put on the market without any knowledge of the previous patented discovery.

[27] Dr. D. J. Hughes, Chairman, Department of Physics, Brookhaven National Laboratory in a letter dated August 16, 1957, to Honorable John Moss, Chairman, Government Information Subcommittee, attributed this number of employees to Professor Shikinov, Director of the All Union Institute of Scientific and Technical Information. Dr. Hughes had just returned from a European trip during which he spent 2 weeks in Poland and 2 weeks in the Soviet Union. During his 2 weeks in the Soviet Union he had the occasion to visit with Professor Shikinov. This number is an increase from the number of 1,800 reported in 1956 by Howard Simons, "Science is Translated," Science News Letter, December 1, 1956, p. 341, and hearings, Independent Offices Appropriations for 1958, before a Subcommittee of the U. S. House of Representatives Committee on Appropriations, 85th Cong., 1st sess., National Science Foundation Report, February 1957, pp. 1383-1384.

[28] Ibid. Dr. Hughes' letter to Chairman Moss, House Government Information Subcommittee. This number is an increase from the number of 13,000 reported in 1956 by Howard Simons "Science is Translated," Science News Letter, December 1, 1956, p. 341, and hearings, Independent Offices Appropriations for 1958 before a subcommittee of the U. S. House of Representatives Committee on Appropriations, 85th Cong., 1st sess., National Science Foundation Report, February 1957, pp. 1383-1384.

[29] Howard Simons, Science is Translated, Science News Letter, December 1, 1956, p. 341, hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, 85th Cong., 1st sess., National Science Foundation Report, February 1957, pp. 1383-1384.

Information systematically translates, indexes, and abstracts over 1,400[30] of the 1,800 scientific journals[31] published in the United States. The institute does not merely abstract the current issues but they have brought issues of earlier years current.[32] The abstract journals also contain new book reviews, patents, and dissertations.

As the preparation and distribution of the abstract journal is a time-consuming job, the institute also publishes 20 Express Information Journals. This journal is designed to get summary information on foreign technological developments into the hands of key Soviet industries and scientists within two or three weeks after their receipt.[33] A random sampling study by the National Science Foundation regarding the Express Information Journal, Issue 19, May 1956 on Metallurgy and Metalworking, determined that the Institute of Scientific and Technical Information translated, evaluated, summarized, and reproduced the material contained in this particular journal within 3 months of its original publication.[34] The Express Information Journals cover general technology, the petroleum industry, radio engineering, agricultural machinery, mining, metallurgy and metalworking, and other subject areas.[35]

The U. S. S. R.'s program of disseminating scientific information to Soviet scientists has made the Soviet Union the world's largest dealer in scientific texts. The Soviet scientists are prolific authors.[36] The best Soviet authors reserve some of their best work for books which often constitute first publication of important research information.[37] The U. S. S. R. freely publishes and distributes scientific monographs including advanced scientific texts in basic sciences that would not attract a very large number of interested readers.[38]

The All Union Institute of Scientific and Technical Information also compiles reviews which summarize progress in specialized fields; it supplies Soviet scientists with complete translations of any scientific paper in any language on request; it supplies photo or microfilm copies of the original article upon request, and it it compiles and supplies technical foreign language dictionaries as additional aids for Soviet scientists and engineers.[39]

The institute maintains an extensive research program on improving transmitting methods and vehicles for the dissemination of scientific information.[40] The Soviets are working on automatic electronic computer translators.[41] The institute claims success in translating scientific texts from English into Russian, and is at present engaged in programing and adapting Japanese, French, Chinese, and German scientific texts into Russian.[42] The Soviets expect to develop a machine that will be able to translate from one language into another with Russian as the medium.[43]

The institute is also working on methods for mechanized searching of scientific literature and the use of electronic storage and retrieval machines for technical

[30] How Good is Soviet Science, Fortune, February 1957, vol. LV, No. 2, p. 119.

[31] Hearings, Availability of Information from Federal Executive Agencies, pt. 4, Panel Discussion on Scientific and Technical Information, House of Representatives Committee on Government Operations, Subcommittee on Government Information, 84th Cong., 2d sess., March 1956.

[32] Dr. Otto Struve, Chairman, astronomy department, University of California, hearings, Availability of Information from Federal Executive Agencies, pt. 4, U. S. House of Representatives Committee on Government Operations Subcommittee on Government Information, 84th Cong., 2d sess., March 1956, p. 829.

[33] Ralph E. O'Dette, Program Director of the Foreign Science Information Program of National Science Foundation, Russian Translation, Science, March 29, 1957, vol. 125, No. 3248, p. 579.

[34] Ibid.

[35] Ibid.

[36] Ibid., see Monthly List of Accessions and Monthly Bibliography of Translations from Russian Scientific and Technical Literature, Library of Congress.

[37] Ibid. as 32.

[38] Dr. Otto Struve, Hearings, Availability of Information, U. S. House of Representatives Committee on Government Operations, Subcommittee on Government Information, 84th Cong., 2d sess., March 1956, pp. 829–831.

[39] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation report, 85th Cong., 1st sess., February 1957, p. 1384. Howard Simons, Science Is Translated, Science News Letter, December 1, 1956, p. 341.

[40] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation report, 85th Cong., 1st sess., February 1957, p. 1384. Memorandum, Soviet Mechanization of Information Processes, available through Office of Scientific Information, National Science Foundation.

[41] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation report, 85th Cong., 1st sess., February 1957, p. 1384. Howard Simons Science is Translated, Science News Letter, December 1, 1956, p. 346. (Similar work is being done in the United States—see National Science Foundation report referred to, p. 1392). Memorandum, Soviet Mechanization of Information Processes, available through Office of Scientific Information, National Science Foundation.

[42] Howard Simons, Science is Translated, Science News Letter, December 1, 1956, p. 341. How Good is Soviet Science, Fortune, vol. LV, No. 2, February 1957, p. 189. Memorandum, Soviet Mechanization of Information Processes, available through Office of Scientific Information, National Science Foundation.

[43] Ibid.

literature.[44] The Soviet Institute hopes soon to be able to machine translate a scientific text, then machine search, index, classify, abstract, store, and retrieve the text at discretion.[45] The material would be stored on magnetic tapes, magnetic drums, wires, magnetic cores, or any other practical storage device so that it could be electronically duplicated and the storage unit rapidly expressed to any area of the U. S. S. R. where it might possibly be helpful to Soviet industry and science.[46]

United States scientists who have visited the U. S. S. R. have been amazed at the Soviets' knowledge of our literature,[47] and some United States scientists have stated that the Soviet scientists probably know our scientific literature better than we know our own.[48] A leading United States scientist has stated that the Abstract Journal of the U. S. S. R.'s Institute of Scientific and Technical Information is by far the most complete effort in the field of abstracting. He said the U. S. S. R. is getting everything that is unclassified and abstracting every article. He has never found an article in his field missing in this Abstract Journal.[49] A British scientist who saw the All Union Institute of Scientific and Technical Information operate felt that no other agency in the world is doing such a thorough job. He wished he could read Russian to have the advantage of their work.[50]

By operation of this system the Soviet scientists, more than any other scientist, has access not only to what other Soviet scientists are doing but also what the scientists of other countries are doing in every field. The institute appears to be successful in its objective of providing communication media whereby the Soviet scientist has at his fingertips all the available pertinent information in the world in all the branches of learning.

III

In the United States there is no governmental agency that operates as a central clearinghouse to search for, collect, translate, index, abstract, and disseminate scientific and technical information in all the branches of learning. Furthermore, there is no private organization performing this function. Our scientists, en-

[44] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation report, 85th Cong., 1st sess., February 1957, p. 1384. V. P. Cherenin, Certain Problems of Documentation and Mechanization of Information Search, Moscow 1955. V. P. Cherenin et al. Experimental Information Machine of the Institute of Scientific Information of U. S. S. R. Academy of Science, Institute of Scientific Information of Academy of Sciences of the U. S. S. R. Journal, Moscow 1955. Professor Panov, Work on Mechanical Translating at the Institute of Scientific Information of the Academy of Science U. S. S. R. M. Bull. 1956. Memorandum, Soviet Mechanization of Information Processes, available through Office of Scientific Information, National Science Foundation, April 15, 1957 p. 4; Dr. L. I. Gutenmakher, New Type Statistical and Information Machines, Vestnik Academy Science U. S. S. R. No. 10, October 1956, pp. 12–21.

In this country we hope to essentially do the same thing. Dr. Vannevar Bush, "The body of issued patents is intended to supply to citizens generally a complete reference in the current state of technical fields in which progress is being made. It has by no means, in recent years, been as valuable in this regard as it might be. This is partly due to its great bulk, and partly due to the difficulty of consulting it in its present form. If it were fully mechanized, and especially if its subject matter included literature references as well as prior patents, it could become very useful indeed. In fact, by making duplicate cards or tapes or the like available, there could be made available to libraries and to industry a highly valuable means of keeping up to date in our rapidly evolving techniques." Proposals for Improving the Patent System, Study No. 1 of the U. S. Senate Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary, 85th Cong., 1st sess., February 1957, Doc. No. 21. See statement Thomas Roy Jones, footnote No. 51. See Recommendations, Advisory Committee on Applications of Machines to Patent Office Operations, 1955.

[45] Memorandum, Soviet Mechanization of Information Processes, available through Office of Scientific Information. National Science Foundation.

The Patent Office and the National Bureau of Standards are engaged in a similar project in this country, but on a smaller scale. This project came about due to the recommendation of the [Bush] Advisory Committee on Applications of Machines to Patent Office Operations. A list of their recent publications are: Mechanized Searching in the U. S. Patent Office, Mr. F. Bailey, et al., J. P. O. S. vol. 35, pp. 566–587. Advances in Mechanization of Patent Searches, Lanham et al., 129th meeting of American Chemical Society, Dallas, April 11, 1956. Storage and Retrieval of Contents of Technical Literature, Andrews et al., U. S. Patent Office Report, May 15, 1956. Problems in Mechanizing the Search in Examining Patent Applications, Newman, U. S. Patent Office Report, October 24, 1956. Punch Card System for Searching Steroid Compounds, Fromm et al., U. S. Patent Office Research and Development Report 7, July 8, 1957. Interrelated Logic Accumulating Scanner ILAS, Andrews et al., U. S. Patent Office Research and Development Report No. 6, June 25, 1957. A First Approach to Patents on a Digital Computer, Pfeffer et al., delivered at Houston, Texas at meeting of Association of Computing Machinery, June 19–21, 1957.

[46] See footnote No. 43 for Bush statement.

[47] What's Science Like in Russia (interview with E. Segre), Chemical Engineering News, vol. 34, p. 4058, August 20, 1956.

[48] Dr. Robert R. Wilson, Scientific Research in the Soviet Union, proceedings of symposium on industrial research at 61st Congress of American Industry, Waldorf-Astoria, National Association of Manufacturers, December 7, 1956, p. 6. E. P. Rosenbaum, Physics in the U. S. S. R. (interview with R. E. Marshak and R. R. Wilson), Scientific American, vol. 195, No. 2, 1956, p. 30.

[49] Dr. Otto Struve, hearings, Availability of Information, before the U. S. House of Representatives Committee on Government Operations Subcommittee on Government Information, 84th Cong., 2d sess., Science Panel, March 1956, p. 829.

[50] How Good Is Soviet Science, Fortune, vol. LV, No. 2, February 1957, p. 119.

gineers, industry leaders, armed services, and the Congress have recognized the need for a central clearinghouse to adequately disseminate technical, scientific, and engineering information.[51]

A survey taken in 1945 indicated industry to be overwhelmingly in favor of a Government agency to act as central clearinghouse to disseminate all nonconfidential scientific and technical information.[52] Executive orders provided for the release, publication, and dissemination of scientific and technical information developed with governmental funds. The Congress has passed laws creating a central clearinghouse. Agencies have been established, but these governmental agencies appear to have never fully assumed the duties delegated to them. So

[51] Hon. Maury Maverick, Chairman and General Manager, Smaller War Plants Corporation: "There must be provided a vigorous mechanism to enable a thorough dissemination of the results of the research brought about through the expenditure of the millions of dollars of taxpayers' money. And, let us remember, taxes comes from little business as well as big business. Unless there is adequate machinery so that the research will go on down and out to our small-and medium-sized manufacturers, then you will have provided only part of the job. We will have a modern research organization all right, but we will still have the same old antiquated "try and get it" method of making the results of Government-paid for research available to an extremely limited number that ought to have it. Indeed, the hideout policy has been in effect before; and the creation of the new body without proper dissemination would be worse than if it had never been created * * * the results of this Government paid for research must not only be available to all—it must be accessible to all; indeed, the information should be widely distributed, it should be open and free, and should be available out in the field, at the crossroads everywhere * * *. There should be the widest possible work-up of information on scientific knowledge for the benefit of the industrialization of this country * * *.

The small manufacturer must not be forced to come to Washington, running the gantlet from pillar to post and bureau to agency, trying to blast out information which should be furnished by the Federal Government in their own communities * * *. I say there must be an agency for that purpose * * * it is the only way we can be prepared for war, or prevent war, with scientific knowledge we can exist as a nation and a stable element for the whole world, and otherwise, we can be blotted out" * * *. Hearings, Science Legislation, U. S. Senate Committee on Military Affairs Subcommittee on War Mobilization, 79th Cong., 1st sess., October 1945, pp. 347–371.

Board of directors of American Chemical Society: "Mere declassification of material is not enough. It must be made available to all who may wish to use it. To accomplish this requires a clearinghouse of the type authorized by this proposed legislation. We believe that such a purpose has great value and that it can only be accomplished by a Federal agency." Statement excerpt, S. Rept. 395, 80th Cong., 1st sess., favoring clearinghouse provision now found in 15 U. S. C. 1152, June 27, 1947, p. 4.

Maj. Gen. Henry S. Aurand, Director of the Research and Development Division of the General Staff: "The wide dissemination of scientific and technical information is the cornerstone of scientific progress. At the present time there is no central clearinghouse either in the Government or in private life for the broad field of scientific and technical information. Government or private research organizations in instituting new projects must sometimes spend considerable sums on preliminary documentary research in order to obtain background materials from many different technical libraries and document collections throughout the United States. Presently existing library procedures are not adequate for the proper cataloging and indexing of technical information from a research and development point of view, since they were designed for the general user and not specifically for the needs of the researcher in seeking new fields of knowledge and new applications of existing fields. The provision for a single agency to record and disseminate scientific information for scientific and technical users should result in reduced cost of research and in accelerated advancement of scientific knowledge" S. Rept. 395, 80th Cong., 1st sess., June 27, 1947, p. 4.

Rear Adm. Paul F. Lee, Chief of Naval Research: "I believe the establishment of a centralized agency in the Government, having full information on all inventions and discoveries, patented or unpatented, which result from current research and development, would be desirable, so long as military information vital to national security is protected" S. Rept. 395, 80th Cong., 1st sess., June 27, 1947, p. 4.

Report excerpt of Research and Policy Committee of the Committee for Economic Development: "The Department of Commerce should expand and improve its services as a clearinghouse to serve the needs of business and disseminate information collected by all Federal agencies which would be useful to smaller firms * * * at both policy and technical levels * * *. The businessman would be greatly helped if there were a central information agency to which he could go to find out * * * what Government services are available to him. Government agencies now have available many different kinds of statistics, research findings, information about new scientific discoveries, and special reports and useful data of all kinds. These services and materials should be made more widely available and should be brought more effectively to the attention of the businessman" S. Rept. 395, 80th Cong., 1st sess., June 27, 1947, pp. 5 and 6.

See statements of Senator George Aiken, chairman, Committee on Expenditures in the Executive Departments; Senator J. W. Fulbright; W. Averell Harriman, Secretary of Commerce; Dr. Edward U. Condon, Director, National Bureau of Standards; Clarence Earle, Maryland Economic Council; National Federation of Small Business; H. A. Kuhn, chemical consultant; Casper Ooms, Commissioner of Patents; and Dr. E. B. Norris, dean of engineering, VPI, hearings, Technical Information and Services Act, Senate Committee on Expenditures in the Executive Departments, 80th Cong., 1st sess., May 1947.

Dr. Watson Davis, director of science service, president, American Documentation Institute, hearings, Science Legislation, U. S. Senate Committee on Military Affairs Subcommittee on War Mobilization, 79th Cong., 1st sess., October 1945, p. 162.

[52] Chairman Harley M. Kilgore of the War Mobilization Subcommittee of the U. S. Senate Committee on Military Affairs, requested the Smaller War Plants Corporation to prepare an industry opinion on proposed science legislation. The answers were gathered from more than 200 representative manufacturers, large and small, in a coast-to-coast survey by technical advisory consultant to the Smaller War Plants Corporation. Question No. 5 of this survey was, "Should the Federal Government distribute nonconfidential scientific and technical information?" Of the firms surveyed, 93 percent favored the Federal Government distributing nonconfidential scientific and technical information resulting from Government research and 86 percent favored the Federal Government distributing nonconfidential scientific and technical information from other sources. Question No. 6 of this survey was, "Through which agency should such nonconfidential information be made available to industry?" Of the firms surveyed, 36 percent favored existing Government agencies to disseminate nonconfidential scientific and technical information to industry, 63 percent favored a central scientific agency to disseminate such nonconfidential information to industry, while 3 percent favored other agencies to disseminate such literature to industry (p. 387)—hearings, Science Legislation, U. S. Senate Committee on Military Affairs Subcommittee on War Mobilization, 79th Cong., 1st sess., October 1945, pp. 383–394.

far, there is no real central clearinghouse to translate, index, abstract, classify, and disseminate scientific, technical, and engineering information, and at present there is no bona fide effort in progress to create such a clearing house.[53] In light of the massive Soviet efforts and their objectives to achieve technological supremacy, the need for a United States clearinghouse to disseminate scientific, technical, and engineering information has never been more demanding.

Executive Orders 9568, 9604, and 9809, respectively, dated June 8, 1945, August 25, 1945, and December 12, 1946, vest in the Secretary of Commerce the authority to determine by review what scientific and technical information developed with governmental funds and classified for purposes of national military security should be released for publication. The Secretary of Commerce is to make recommendations to the Secretaries of the armed services whose decisions shall be final. When such scientific and technical information may properly be released, the Secretary of Commerce shall promptly publish the information. To assist the Secretary of Commerce in his duties, these orders establish a Publication Board consisting of the Secretary of Commerce as Chairman, the Attorney General, the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Labor. The Secretaries of the armed services and the Chairman of the National Advisory Committee for Aeronautics are allowed one liaison officer who may attend the meetings and participate in the Board discussions. The function of the Board shall be to bring to the attention of the Secretary of Commerce any information within the scope of the orders and to advise with him concerning its release. The Secretary may utilize governmental and private agencies and personnel to carry out these functions. The above Executive orders are still in force; they have never been amended or rescinded.

After extensive hearings, the Congress enacted on May 10, 1950, the National Science Foundation Act of 1950. This act established as an independent agency the National Science Foundation.[54] The Foundation is authorized and directed to foster the interchange of scientific information among scientists in the United States and foreign countries and also to provide a central clearinghouse for information covering all scientific and technical personnel in the United States.[55] The Foundation has the authority to publish or arrange for the publication of scientific and technical information so as to further the full dissemination of the information of scientific value consistent with the national interest.[56]

At the request of the Secretary of Commerce the chairman of the United States Senate Committee on Interstate and Foreign Commerce submitted a bill to provide the Department with explicit authority to establish a clearinghouse to collect technical information from whatever source available and to disseminate such information to business, industry, and general public and also to provide a statutory basis for the Department's responsibility to recommend the declassifica-

[53] The following statements indicate the ineffectiveness of any alleged, existent central clearinghouse for the dissemination of scientific and technical knowledge:

Roy Sheen, president, Instrument Society of America: "The fourth need in this broad field of instrumentation-automation has to do with the efficiency of the people working in it and has basically to do with communications. I am speaking broadly here of the need of a central clearinghouse for the rapidly accumulating information and knowledge. This would avoid, at least in some degree, the duplication of valuable time by a number of workers on a similar subject, all of whom are achieving a common result but without knowledge of the work of the other, thus wasting valuable time which otherwise would have been saved," hearings, Instrumentation-Automation, Joint Committee on the Economic Report, 84th Cong., 2d sess., December 1956, p. 13.

Chairman Wright Patman: "Your idea about a central clearinghouse for the rapidly accumulating information of knowledge, I think is a wonderful suggestion," hearings on Instrumentation-Automation, Joint Committee on the Economic Report, Subcommittee on Economic Stabilization, 84th Cong., 2d sess., December 1956, p. 32.

Dr. Stanley Livingston, professor of physics, MIT: "Again, I believe that it is proper that there should be some improved system for distributing information in a way which would make it more useful," hearings, Availability of Information, U. S. House of Representatives Committee on Government Operations Subcommittee on Government Information, 84th Cong., 2d sess., March 1956, p. 738.

Thomas Roy Jones, president, Daystrom Corp.: "In the automation field there is a great need for effective communications so that the work done by one group and the experiences of all groups can be made available to everyone who has a need for the information. With the shortage of manpower, with the needs for instrumentation-automation research and development and application, and with the urgency of needs in many of these areas, it is criminal for people to spend time rediscovering the truths already known—to go through all the growing and application pains which have previously been experienced by others. We need fundamentally a basic system of communication in this country by which the accumulated knowledge and experience of all can be made available to all. We need an effective instrumentation-automation information, storage and retrieval system. This would embrace statistics of the industry and of the markets, technological developments and operational experience * * *. First, the Government should consider the establishment of a centralized, information-coordination storage and retrieval system, cooperatively planned, operated, and utilized by Government and industry," hearings, Instrumentation-Automation, Joint Committee on the Economic Report, Subcommittee on Economic Stabilization, 84th Cong., 2d sess., December 1956, pp. 38–40.

[54] 42 U. S. C. 1861.

[55] 42 U. S. C. 1862.

[56] 42 U. S. C. 1870.

tion of technical information which previously had not been available to the public for reasons of national security.[57]

On September 9, 1950 the Congress enacted chapter 23 of title 15 of the United States Code entitled "Dissemination of Technical, Scientific, and Engineering Information", which provides the explicit statutory authority sought.[58] The Secretary of Commerce is given the authority to search for, collect and catalog scientific and technical information from foreign and domestic sources. He is to make such information available to industry, agencies of State and Federal Governments, and to the general public through the preparation of abstracts, digests, translations, bibliographies, indexes, and microfilm and other reproductions and to distribute this material by any publication or service.[59]

The Secretary of Commerce is further directed to refer to the armed services all scientific or technical information, coming to his attention, which may have potential military significance, and to refer to other Government agencies such scientific or technical information as relates to activities within the primary responsibility of such agencies.[60]

To carry out the purposes of the statute the Secretary of Commerce may utilize any personnel, facilities, bureaus, agencies, boards, administrations, offices or other instrumentalities of the Department of Commerce and any other governmental or private instrumentalities with their consent.[61]

Executive Order No. 10521, March 17, 1954, provides that Federal Agencies supporting or engaging in scientific research shall, with the assistance of the National Science Foundation, cooperate in an effort to improve the methods of classification of reporting of scientific research projects and activities, subject to the requirements of security of information. Furthermore, the Foundation is required to make comprehensive studies and recommendations regarding the Nation's scientific research effort and its resources for scientific activities, including facilities and scientific personnel, and its foreseeable scientific needs, with particular attention to the extent of the Federal Government's activities and the resulting effects upon trained scientific personnel; the Foundation is also required to recommend to the President policies for the Federal Government which will strengthen the national scientific effort.

Seven years have passed since the National Science Foundation was established by law and its policies and operations are now ascertainable. The Foundation has made no comprehensive studies and recommendations regarding the dissemination of scientific, technical, and engineering information and has not recommended to the President a policy for the Federal Government which will strengthen the national scientific effort through greater emphasis on disseminating scientific, engineering, and technical information. It appears the Foundation has taken the policy position that the national interest does not warrant a much greater effort than what is now being done to further the full dissemination of the information of scientific value. The Foundation has no plans for establishing or operating a formal national clearinghouse for all scientific information.[62]

The Foundation did set up about the first of this year a section in its Office of Scientific Information called the Government Research Information Clearinghouse,[63] This section acts as a consulting service only on Government scientific reports.[64] Its objective is to aid the basic scientist to find out whether unclassified Government reports are being issued in his field and, if so, how copies can be obtained.[65] This alleged clearinghouse does not handle these research reports, nor is it concerned with nongovernmental and foreign scientific and technical information.[66] The National Science Foundation has taken the position that, in the United States, it does not appear to be feasible or desirable to centralize in the Government the preparation of abstract journals and other types of scientific information services.[67]

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[57] S. Rept. 675, 81st Cong., 1st sess, July 14, 1945.
[58] 15 U. S. C. 1151.
[59] 15 U. S. C. 1152.
[60] 15 U. S. C. 1154.
[61] 15 U. S. C. 1156.
[62] Dr. Alan Waterman, Director, National Science Foundation, in a letter dated May 22, 1957, to the Honorable John Moss, chairman, Government Information Subcommittee.
[63] Dr. Dwight E. Gray, Program Director, Office of Scientific Information, National Science Foundation, "Scientists and Government Research Information," College and Research Libraries, January 1957, p. 27.
[64] Ibid., p. 27, Government Research Information, Objective of the GRI Program and Operations of GRI Program. U. S. Government Printing Office 1956, O–406938.
[65] Ibid.
[66] Ibid.
[67] Hearings, "Independent Offices Appropriations for 1958," National Science Foundation, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, p. 1384. See the results of industry survey taken by Smaller War Plants Corporation in 1945 in hearings which led to the passage of the National Science Foundation Act—footnote 52 and also statements of Thomas Roy Jones and Roy Sheen, footnote 50.

The Foundation has taken this position despite its own findings of fact. The Foundation discovered that only 6,000 of the more than 20,000 unclassified Government reports issued annually are ever announced to the public,[68] and a very small percentage of these reports find their way into journal publication.[69] The average timelag between report issuance and journal publication of the few reports that are published is over a year and a half.[70] Other shortcomings are: The unclassified Government research reports with the exception of certain intralaboratory series do not follow the volume-number system of the journals,[71] few Government scientific reports are abstracted or indexed by standard secondary publication mediums, and, in general, each issuing agency establishes its own preparation rules,[72] the reports are subject to little standardization of style, format, and content,[73] therefore the existing announcement and dissemination of Government-sponsored research do not fully meet the needs of United States scientists.[74]

The Foundation found that it is possible to receive, upon the quest, any Soviet scientific and technical publication. However, the greater part of these publications lie untouched as we have neither the manpower nor the desire to translate this material.[75] In several areas the Foundation has discovered that the most efficient and authoritative means for improving United States coverage is to translate directly from the Soviet's abstract journal dealing with the particular science.[76]

It is obvious from these findings by the Foundation that a central clearinghouse is needed to handle all the difficult problems involved in disseminating scientific and technical information. The Foundation, however, has proceeded from sound premises of fact to an unsound conclusion and policy; it supports mere piecemeal importation, translation, abstraction, publication, and dissemination of foreign and domestic scientific and technical information.[77]

Over 11 years have passed since Executive Orders 9568, 9608, and 9809 were promulgated and nearly 7 years since chapter 23 of title 15 of the United States Code was enacted. The Department of Commerce's operations to carry out its mandatory duties to establish a central clearing house to collect, release, and disseminate technical, scientific, and engineering information are, indeed, limited in scope. The Office of Technical Services in the Department of Commerce operates under the authority granted by the Executive orders and title 15, United States Code sections 1151–1157. This agency publishes a monthly subscription announcement service and a subscription newsletter which list annually some 6,000 of the 20,000 and more Government research reports and explain how copies of the documents can be obtained.[78] It also acquires copies of the reports listed in its monthly announcement, and catalogs and stocks them for sale distribution. As a result of supplemental grants from the National Science Foundation, the Office of Technical Services is now attempting to include basic research reports as well as applied science reports.[79] This agency also distributes overrun copies of comprehensive unclassified science bibliographies put out by the Science Division of the Library of Congress.[80] Currently, there are only 34 employees in the Office of Technical Services engaged in the acquisition, organization, and distribution of scientific material.

There does not appear to be in the Department of Commerce an organization that regularly reviews classified scientific and technical information to determine whether a recommendation should be made to the competent authority to declassify and release such scientific and technical information.[81] One never hears of any action taken by the Interdepartmental Publication Board concerning the release of scientific information. It is the mandatory function of the Secretary of Commerce to establish a clearinghouse for the collection and dissemination of

[68] Dr. Dwight E. Gray, Program Director, Office of Scientific Information, National Science Foundation, "Science and Government Research Information," College and Research Libraries, January 1957, pp. 23 and 25.
[69] Ibid., p. 24.
[70] Ibid., p. 24.
[71] Ibid., p. 23.
[72] Ibid., p. 23.
[73] Ibid., p. 23.
[74] Ibid., p. 24.
[75] Ibid., pp. 1389–1390.
[76] Ibid., pp. 1384–1388.
[77] Hearings, "Independent Offices Appropriations for 1958," before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation, p. 1274.
[78] Government Research Information, U. S. Government Printing Office, 1956, O–408938.
[79] Ibid.
[80] Ibid., p. 26.
[81] Wm. Sunderland, "Navy to Help Harvard 'Bail Out' Documents," The Washington Post and Times Herald, August 11, 1957, p. A–10. Letter of Chairman Moss, House Government Information Subcommittee to Hon. Charles E. Wilson, Secretary of Defense, May 24, 1957.

scientific, technical, and engineering information,[82] yet, there appears to be no organization in the Department of Commerce that searches for, collects, classifies, coordinates, and catalogs such information, from whatever source available as provided by law. Nor does any agency of the Department make such information public through the preparation of abstracts, digests, translations, bibliographies, indexes, and microfilm and other reproductions, for prompt distribution[83] as contemplated by law.

The House Government Information Subcommittee[84] of the House Government Operations Committee has made a preliminary start in attempting to determine if the Department of Commerce and the National Science Foundation are carrying out the congressional mandate to set up a clearinghouse for the collection and dissemination of scientific, technical, and engineering information.[85] However, the Department of Commerce so far appears reluctant to answer the queries of this subcommittee even though the information is necessary to carry out the statutory duties assigned the subcommittee.[86] The Department had not, by August 15, 1957, answered a letter from this subcommittee, dated March 25, 1957, requesting information on what the Department is doing to carry out the provisions of the act of Congress relating to technical information.[87]

Adm. Lewis L. Strauss, Chairman of the United States Atomic Energy Commission, in a recent address remarked:

"New ideas and newly developed technology, as they flow from Government research and development, might be more readily available to small firms if all the Government agencies engaged in such programs were to consider establishing a central clearinghouse for their unclassified data. It may well be that what we publish is too inaccessible in form and scientific language—kept, let us say, on too high a shelf. It may well be that the Government should review its procedures to make what it has available and which belongs to all the people more readily available."

Thus, it appears from the statement of Admiral Strauss and other eminent leaders[88] that the Department of Commerce is not complying with the congressional mandate to set up a central clearinghouse to coordinate, integrate, collect, and disseminate governmental scientific and technical information for the benefit of industry, science, and the general public.

IV

The U. S. S. R. has established an operating central clearinghouse which searches for and collects all the world's scientific, technical, and engineering information. Therefore, if this apparatus functions efficiently the U. S. S. R. will be able to exploint the world's scientific, technical, and engineering literature for economic gain. In the United States, the Department of Commerce does not effectively carry out its mandatory function to establish a central clearinghouse to collect and disseminate worldwide scientific and technical information. The National Science Foundation has not formulated a policy for recommendation to the President which would strengthen the national scientific effort through the operation of a central clearinghouse which would integrate, coordinate, and aid in the dissemination of scientific and technical information.

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[82] See footnote 52. Mandamus lies to compel any executive or administrator to perform a particular act or duty imposed by law. Rule 81 (b) of the Federal Rules of Civil Procedure has abolished the writ of mandamus. Relief is still available by filing a civil action and the substantive rights of the parties are governed by the principles which were formerly applicable in mandamus cases. (67 Wash. Law Rep. 1162.)

[83] Department of Commerce also believes the present flow of scientific information among the Federal agencies is adequate. Hearings, "Availability of Information from Federal Executive Agencies," Panel No. 4, Discussion in Scientific and Technical Information, U. S. House of Representatives Committee on Government Operations Subcommittee on Government Information, p. 847.

[84] Moss subcommittee.

[85] Hearings, "Availability of Information from Federal Executive Agencies," Panel No. 4, Discussion on Scientific and Technical Information, U. S. House of Representatives, Government Operations Committee on Government Information.

[86] Robert Coll, "United States Held Blind to Red Science," Washington Post and Times Herald, August 5, 1957, p. A–9.

[87] Ibid. The Moss subcommittee received an answer from the Department of Commerce dated August 16, 1957.

[88] Remarks prepared by Lewis L. Strauss, Chairman, U. S. Atomic Energy Commission for delivery to President's Conference on Technical and Distribution Research for the Benefit of Small Business, Washington, D. C., September 25, 1957.

See footnote 53.

Hon. Fritz Lanham, "There is no comparative unit as the Russian Institute in our Government * * *. I thought it well to bring this to the attention of the committee. We need a central clearinghouse for available information and data. I think the authority exists, and the funds to carry on this work likely would not be very great, but it is highly important if we are to maintain our present eminence in the field of scientific development." Hearings, "Department of Commerce and Related Agencies Appropriations for 1958" before a subcommittee of the U. S. House of Representatives Committee on Appropriations, 85th Cong., 1st sess., p. 964.

The importance of these facts cannot be overestimated. We are involved in a race for supremacy with the U. S. S. R.—a global cold war for survival. This war for survival involves ideologies, scientific and technical leadership, economic dominance, and weapons plus counterweapons superiority. Our basic freedoms and standard of living are at stake.

The department given the duty to set up such a clearinghouse should promptly move to carry out its responsibilities, or the congressional mandate should be taken away and delegated to a more responsible Government organization.

The U. S. S. R. has already caught up with—and sometimes passed—the United States in aeronautics,[89] catalysis,[90] metallurgy, [91] high energy physics,[92] data computers,[93] reaction kinetics chemistry,[94] geophysics,[95] earth drilling,[96] meteorology,[97] oceanography,[98] and some other fields. Technological advances in the past 25 years have given our Nation temporary world dominance in synthetic fibers, plastics, automotive equipment, electrical equipment, electronics, glass, chemicals, drugs, aeronautics and many other areas. However, technological leadership cannot be taken for granted since scientific and technical changes are made daily. If we allow the U. S. S. R. to surpass our Nation in technology, it will only be a short period of time before they adapt their technological advances to gain world economic and weapon supremacy.

To maximize our chance for survival as a free, democratic nation, with a prospering economy, we must provide our industry and scientists with adequate communication mediums, so that they, like their Soviet counterparts, will readily have available all the necessary information relating to their problems. We owe it to our taxpaying public and industry to make promptly and easily available all nonclassified scientific and technological information developed with Government funds. We must have a trained organization to constantly review classified scientific and technological information to determine whether a recommendation should be made to declassify and disseminate this information. We must do this job and do it well, for the U. S. S. R. is doing such a complete and thorough job that Soviet industry and scientists now have better access to our research than our own industry and scientists.

Dr. SHERA. I have also, as exhibit No. 5, a statement summarizing U. S. S. R. activities in exploiting recorded scientific information.

This was a document which was distributed a year ago, April 15, 1957, by the National Science Foundation, which, again, is, I think, a good, clear statement of what is going on in the Soviet Union at the present time, respecting mechanized information searching.

Senator HUMPHREY. Exhibit No. 5 will be made a part of the record without objection.

(The exhibit referred to is as follows:)

EXHIBIT No. 5

STATEMENT SUMMARIZING U. S. S. R. ACTIVITIES IN EXPLOITING RECORDED SCIENTIFIC INFORMATION

SOVIET MECHANIZATION OF INFORMATION PROCESSES

PREFACE

For effective research work, scientists and technologists need to know what their counterparts are accomplishing elsewhere in their own country, and in other parts of the world. Because of the tremendous and still growing volume of printed matter dealing with science and technology, it is no longer possible for

[89] Howard Simons, Russian Science Today, Science News Letter, December 1, 1956, p. 339. How Good Is Soviet Science?, Fortune, vol. LV, No. 2, p. 117; examples, Soviet Air Force Jets Bison, Farmer, and TU-104, TU-104A, TU-110, and Rossiva jet passenger airplanes; Soviet rocket and missile development.

[90] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, p. 190.

[91] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, p. 194.

[92] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, pp. 189 and 190. What's Science Like in Russia?, Chemical and Engineering News, vol. 34, No. 34. August 20, 1956, pp. 4058–4066 (interview with E. Segre), E. P. Rosenbaum, Physics in the U. S. S. R., interview with two United States physicists, Scientific American, vol. 195, No. 2, August 1956, pp. 29–35.

[93] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, February 1957, p. 189.

[94] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, February 1957, pp. 190 and 192.

[95] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, February 1957, p. 194.

[96] Hearings, Independent Offices Appropriations for 1958, before a subcommittee of the U. S. House of Representatives Committee on Appropriations, National Science Foundation, 85th Cong., 1st sess., p. 1387.

[97] How Good Is Soviet Science?, Fortune, vol. LV, No. 2, February 1957, p. 194.

[98] Ibid., p. 194.

individuals or teams using traditional methods to search effectively, literature bearing on any particular area of research. Equipment such as punch cards offers only an interim solution.

This report reflects Soviet realization of these facts, and outlines the research and developmental program on mechanization of information processes that is taking place in the U. S. S. R. It should be noted that research on the overall problem of information processing has two major facets: (*a*) The short-range aspect which concerns storage and retrieval; and (*b*) the long-range aspect which concerns assessment and evaluation. This paper deals primarily with the former.

SUMMARY

The U. S. S. R. is concentrating great effort and resources to find sophisticated methods of mechanizing scientific and technical information retrieval and related processes. Experimentation is efficient and extensive. It is believed that basic principles for storage and retrieval of information have been established and that fundamental concepts leading to mechanical means of information analysis have been realized. Many research trends in the U. S. S. R. resemble those in the West.

The future vitality of Soviet science depends in part on maintaining a familiarity with research accomplishments and currents of thought among their own scientists as well as with those in other countries. As direct access to foreign scientists is threatened by international political events, Soviet incentive to have rapidly accessible a current, workable fund of world scientific and technical data grows stronger. Thus, we see a motivation behind Soviet efforts in this area which is stronger than that in the West.

The Soviet All-Union Institute of Scientific and Technical Information is the world's largest center for processing scientific and technical data, and information control through mechanized processing is the most likely solution to the institute's servicing problem. As previously indicated, strong efforts are being directed toward this solution; but it is not feasible to forecast accurately when this will be accomplished.

DISCUSSION

To find solutions to information storage and retrieval problems is a major operation in the Soviet scientific effort. For several years research has been concentrated on electronics to solve problems which go beyond traditional documentation methods. The application of modern technology, including analog and digital computers and other electronic means to data processing has been studied.

The ultimate goal of Soviet long-term research in this area is aimed at mastery of the electronic brain and is similar to that in the West: application of numerical processing to dynamic situations. Specifically, the ultimate aim is to develop a machine method of analyzing and synthesizing information thereby substantiating old concepts or arriving at new, logical conclusions.

Soviet immediate, short-term research has been directed toward creating an information language and concurrently toward mastering mechanical translation. Soviet experiments with mechanical translation have indicated fair practical competence and a level of theoretical comprehension on a par with that of the West.

Experimentation in the U. S. S. R. on information retrieval and related processes is impressive mainly because of its massive and efficient organization. In mid-1952, the first published Soviet work in information control appeared in the scientific press of the U. S. S. R. in the form of an article by Doctor of Technical Sciences L. I. Gutenmakher. This article outlined some of the principles behind creating an information language and emphasized the urgency of proceeding beyond the IBM-type punchcard machine system in information processing.

Gutenmakher is head of a laboratory of electrical modeling at the Institute of Precision Mechanics and Computer Engineering of the U. S. S. R. Academy of Sciences. It is at this institute, under the directorship of Academician S. A. Lebedev, that the most important basic research and development in the U. S. S. R. on computer mechanisms is done.

In late 1952 an information institute was organized in the Academy of Sciences, U. S. S. R. Its personnel were given the task not only of supplying information, but also of finding the best means of doing so. A computer specialist, Doctor of Technical Sciences D. Yu. Panov, was assigned directorship of the institute. Panov had a background in information theory and applied mathematics and

had been deputy director of the aforementioned computer institute. Some time in 1954, personnel of the information institute, working with equipment and personnel at the Academy of Sciences' computer institute, began developmental research on mechanical translation. By 1956, they had achieved practical results with computer runs.

Experimentation on mechanical translation has included work using both the Strela–1 and BESM Soviet computers. The most successful experiments reported were performed on the BESM, which is a high-speed device comparable to some of the foremost operating digital computers in the United States. In January 1956, the BESM was programed for a demonstration working from English to Russian. For the demonstration, dictionaries of 952 English words and of 1,073 Russian words were used to obtain sample translation of material from Milne's Numberical Solution of Differential Equations. The machine program involved about 20,000 operations.

In September 1956, D. Yu. Panov was in the United States to attend an international symposium on information theory at Massachusetts Institute of Technology and to visit whatever United States documentation and computer centers he could. At that time, Panov confirmed that English to Russian mechanical translation had been successfully mastered and that experiments were underway to perfect Japanese, Chinese, and German translations into Russian. It was the opinion of United States experts who attended the MIT meetings that the U. S. S. R. had solved the intellectual problems of mechanical translation and that they needed only to iron out a few mechanical difficulties.

While in the United States, Panov met with representatives of the National Bureau of Standards' Computer Laboratory to discuss machine characteristics and experiments on the interconnection of computers and information retrieval. Discussions on computer developments both at NBS and in the U. S. S. R. indicated considerable familiarity on the part of the Russians with United States work.

Perhaps the most immediate requirement of information retrieval accomplishments in the Soviet Union is for successful control of the voluminous amount of scientific and technical information processed there. As the Soviets' short-lived accessibility to direct international contact is threatened by the international political climate, availability of the printed word gains increasing importance. Soviet scientists and technologists have to be aware not only of thought currents among themselves, but also among scientists of other countries.

The information institute of the Academy of Sciences was designed to fill this need. By 1956, it had quadrupled in size and stature. It became the All-Union Institute of Scientific and Technical Information, or VINITI, operating under dual authority: scientific information being the responsibility of the Academy of Sciences, U. S. S. R.; and technical information, the State Committee for New Technology, Council of Ministers, U. S. S. R.

This centralized, state-subsidized institute is the world's largest information center devoted solely to science and technology. As demonstration of the scope of its activities, the institute receives, processes, and distributes information on all Soviet, most East European, and about 10,000 western scientific and technical publications. It has a permanent staff of over 1,800 and contracts about 13,000 working scientists and technologists in the U. S. S. R. and abroad for abstracting services. The most important service which this institute can render is to furnish on demand current and rapid surveys of problems or of work underway in any scientific or technical field. To do this, the information retrieval processes must be mechanized.

In the Soviet Union, as elsewhere, the study of mechanizing information processes is a joint effort by specialists in the fields of information theory, computers, and electronics. One indication that the Soviets may be meeting with difficulties in technical developments is the fact that in late 1956 D. Yu. Panov was relieved of the directorship of VINITI and returned to computer work at his former post of deputy to Lebedev at the Institute of Precision Mechanics and Computer Engineering. Panov's release from administrative duties, in spite of a good record, and his return to computer work may imply that the Soviets are meeting with greater problems than expected and that Panov's experience in application of theory is required.

In October 1956, L. I. Gutenmakher published a second article on information control, this time discussing "new types of statistical and information machines in the U. S. S. R." Gutenmakher presented neither details of existing information machines nor details of current Soviet research. Rather, he indicated certain research trends and discussed the potential applications of information machines in the future. The article showed a thorough and sophisticated understanding of all the problems involved.

The information machine of the future, as described by Gutenmakher, must have a large storage capacity, permit rapid access to information, and give permanence of storage. He stated that the basic principles for development of a purely electrical, mechanically immobile, information reading system had been established. Information would be stored in the form of binary digits, not as isolated abstracts or bits of information, but as complete texts. The text would be recorded on long-duration memory sheets, or code sheets, and electrically joined to a common circuit. On information retrieval, Gutenmakher states that in 1 hour more than 10 billion digits could be read, the equivalent of 4 million pages of ordinary text.

For immediate potential application of information machines, Gutenmakher noted analysis of industrial operations and processing of scientific information. The first task for scientific information processing would be to record on code sheets, all material contained in 50 years of the United States Chemical Abstracts and 4 years of the Soviet equivalent. The second task would be to record indexes of abstract journals on engineering, agriculture, physics, and medicine, and eventually the entire world fund of annotated literature on natural sciences.

For the future, Gutenmakher envisages an encyclopedic machine containing the entire contents of all scientific works. Using a logical means for the investigation of material, and with the aid of the machine, he foresees the possibility of establishing new conclusions from premises related to two different fields of knowledge.

Gutenmakher also notes difficulties to be encountered, primarily of space and perception. The problem that will be encountered as the result of storage space increase, he states, is of a purely technical nature and can be overcome by introducing an auxiliary machine to supply the required information language. It is for this reason, he points out, that work on the theories and techniques of translation machines is important. Comprehension of these theories and techniques will facilitate solution of the problems involved in the conversion of texts and questions into a single structure in the information machine.

The latest Gutenmakher article opens with the statement, "In the next few years, our scientists will have the task of developing a series of high-speed machines for analyzing [9] the content of a world fund of scientific and technical literature * * *." It closes with, "* * * the development of such machines requires greater work on the part of the Academy of Sciences and industry."

United States opinion of Soviet work on information handling is that the U. S. S. R. has a good comprehension of the problems involved but lags on equipment. This is, of course, equipment as described in the Soviet scientific press. It is impossible to forecast a date time for completion of a product in the Soviet Union which can successfully mechanize information processes at the level desired. However, Soviet motivation behind such research is strong enough so that their efforts will not suffer from lack of personnel or funds. There is also an element of international prestige involved. An International Conference on Scientific Information is scheduled for the fall of 1958, and it is possible that aside from meeting domestic requirements, the Soviets may have set this conference as a target date for completing a machine that will successfully solve problems of processing data.

Dr. SHERA. I think that is all we have on the Russian situation.

Some of this you will find repetitious. I would say this article in the Bar Journal is certainly one of the best sources.

Now, turning to the situation in the United States, we are not arguing, of course, that we should slavishly copy the Russians or that we should copy the Russians at all. Our situation is entirely different.

As your chairman pointed out, we have in this country a number of existing bibliographic services in chemistry, in physics, in mathematics, that are doing excellent pieces of work; so, our problem is not to duplicate their work or to write them out of existence, but to coordinate all this effort so that what we do here fits into the American pattern of voluntary cooperation between private industry, Government, and the academic institutions, rather than any kind of decree setting up some super documentation center, bibliographic center, such as they have in the Soviet Union.

[9] Refers to information storage and retrieval processes.

Exhibit No. 6 is a survey of——

Senator HUMPHREY. May I ask my colleagues, here, before you proceed:

What would be your wish in reference to this supporting material in exhibit No. 6, which is a survey of United States activities?

There are a number of charts which I gather can be reproduced for purposes of testimony.

It has been my personal desire—and I only express it here for your thoughtful consideration—that we might want to get together here for once in a hearing as much material as we could on this subject matter; so that our colleagues or others who study this hearing would have it all in one place and will not have to go through files.

So, if there is no objection, we will discuss each exhibit. We will have exhibit No. 6 made a part of the testimony.

Is that agreeable?

Dr. SHERA. Thank you.

(The exhibit referred to is as follows:)

EXHIBIT No. 6

SURVEY OF UNITED STATES ACTIVITIES IN EXPLOITING RECORDED SCIENTIFIC INFORMATION

TRENDS IN INFORMATION SERVICES—UNITED STATES VERSUS U. S. S. R. DEVELOPMENTS IN SCIENTIFIC AND ENGINEERING FIELDS

(By Allen Kent and Robert E. Booth, Center for Documentation and Communication Research, Western Reserve University, Cleveland, Ohio)

(Paper presented before Symposium on Systems for Information Retrieval, April 16, 1957, Masonic Auditorium, Cleveland, Ohio)

I. INTRODUCTION

Two events recently came to our attention regarding coordinated information processing in the United States and in Russia.

(*a*) *Some U. S. S. R. activities*

The All-Union Institute of Scientific and Technical Information, U. S. S. R., announces [1] the buildup of information services from 1953 to the present whereby:

(1) Abstracts of 400,000 scientific and technical papers published annually throughout the world are being prepared and disseminated in the U. S. S. R. to subject specialists in 12 fields:

Astronomy and geodesy	Electrical engineering	Mathematics
Biological chemistry	Geography	Mechanics
Biology	Geology	Metallurgy
Chemistry	Machine building	Physics

(2) A permanent staff of 1,800 has been assembled (all university graduates), and a part-time abstracting group of 13,000 scientific and technical specialists has been recruited.

(3) An experimental information machine was designed in hopes of mechanizing the institute's card index system and speeding up classification of scientific publications. Also publicized was the successful programing of the Soviet high-speed electronic computer to translate English into Russian.

This U. S. S. R. source further discusses the creation of a central electronic information searching system based on high-speed computerlike devices in which scientific information has been entered in a specially designed machine language. In another recent publication [2] immediate steps are proposed which will involve the recording for machine search "the material from Chemical Abstracts for the past half century."

[1] D. Yu Panov, Institute of Scientific Information of the Academy of Sciences of the U. S. S. R., International Congress on Documentation of Applied Chemistry, London, November 22-25, 1955.

[2] L. I. Gutenmakher, New Type Statistical and Information Machines, Vestnik Akademic Nauk SSSR, No. 10, pages 12-21 (October 1956).

(b) *Some United States activities*

The second event—in the United States—concerns the announced curtailment of centralized services by the Armed Services Technical Information Agency (ASTIA) with regard to dissemination of information on Government-supported research. Further, in a public address, a spokesman for ASTIA indicated that mechanical aids for the information search process do not appear feasible.[3]

Just last month, in an official report to the American Chemical Society from the director of the Chemical Abstracts Service, the following statement was made with regard to Chemical Abstracts research activities:[4]

"* * * the research department is informed and competent as to mechanization developments and possibilities in our kind of work and service, and will help us to keep CA methods effective and modern without any sacrifice in standards. No further mechanization of abstracting and indexing operations has been found to be feasible as yet * * *."

In examining these apparently divergent points of view, we are left with a feeling of perplexity regarding the underlying reasons for the differences of opinion expressed in the U. S. S. R. and the United States statements. Accordingly, we began to explore the reasons in terms of some general questions, as follows:

1. What are the needs and desires of the users of scientific and technical information in the United States?
2. Are United States information users more individualistic and prefer to avoid the use of central and mechanized services?
3. What are the economic stakes involved in the use of recorded information in the United States?

II. QUESTIONNAIRE ON ABSTRACTING AND INDEXING ACTIVITIES OF INDIVIDUAL ORGANIZATIONS

Recognizing abstracting and indexing to be the cornerstones of many information services these three general questions were then formulated in terms of a 3-page questionnaire, which was sent to the approximately 2,000 special librarians for the organizations listed in the 1953 LSA directory.

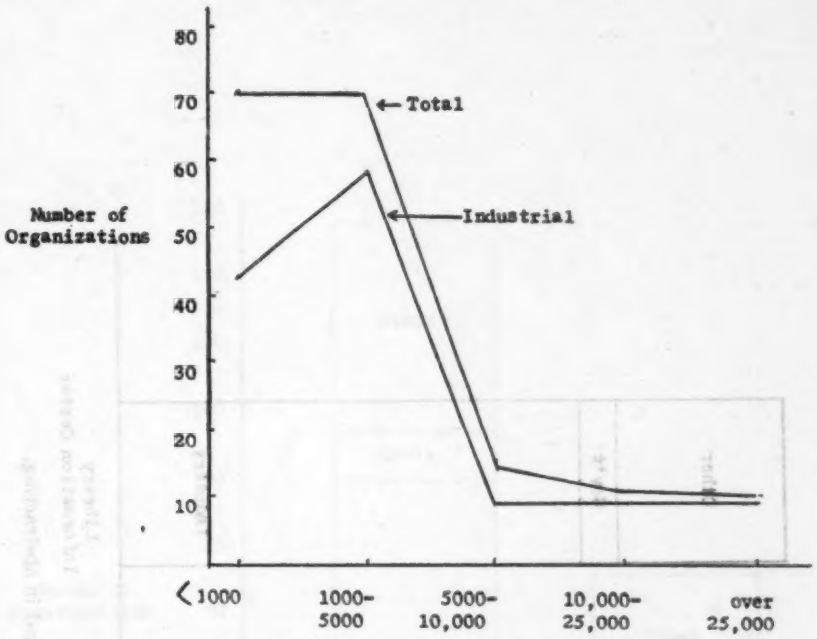
Let us consider some of the questions asked and a preliminary breakdown of the replies received (604 questionnaires were returned).

The first question concerned the abstracting of published papers within the company or organization for the benefit of employees.

Of those replying to this question (180), an overwhelmingly large percentage prepared up to 5,000 abstracts during 1956. (See fig. 1.)

[3] F. K. Fagen, ASTIA Blue Sky, paper presented before Institute on Special Librarianship and Documentation, Pittsburgh, Pa., June 8, 1956.
[4] E. J. Crane, Chemical Abstracts, Chem. Eng. News, 35, 74-76, (Mar. 11, 1957).

FIGURE 1.—Number of abstracts prepared.



The abstracting was performed mainly by a professional library, information center, or documentation staff. However, a significant percentage of organizations reported that research or technical staff was engaged in the abstracting of published papers. (See fig. 2.)

Abstracts prepared by the various organizations are being distributed mainly in the form of an abstract bulletin. However, about a third of the organizations records and distributes abstracts internally on unit records (cards, etc.). (See fig. 3.) About 6 percent of the reporting organizations coordinated their abstracting and indexing operations with a machine searching system.

Of those who performed centralized abstracting, and who provided us with figures for the amounts of money expended by their organization for abstracting and indexing activities per year, a breakdown of amounts spent during 1956 is shown in figure 4.

One of the advantages shown by organizational abstracting services is promptness of issue of abstracts after publication of original articles. The average lapse of time between date of publication of original articles and issue of company abstracts was reported as shown in figure 5.

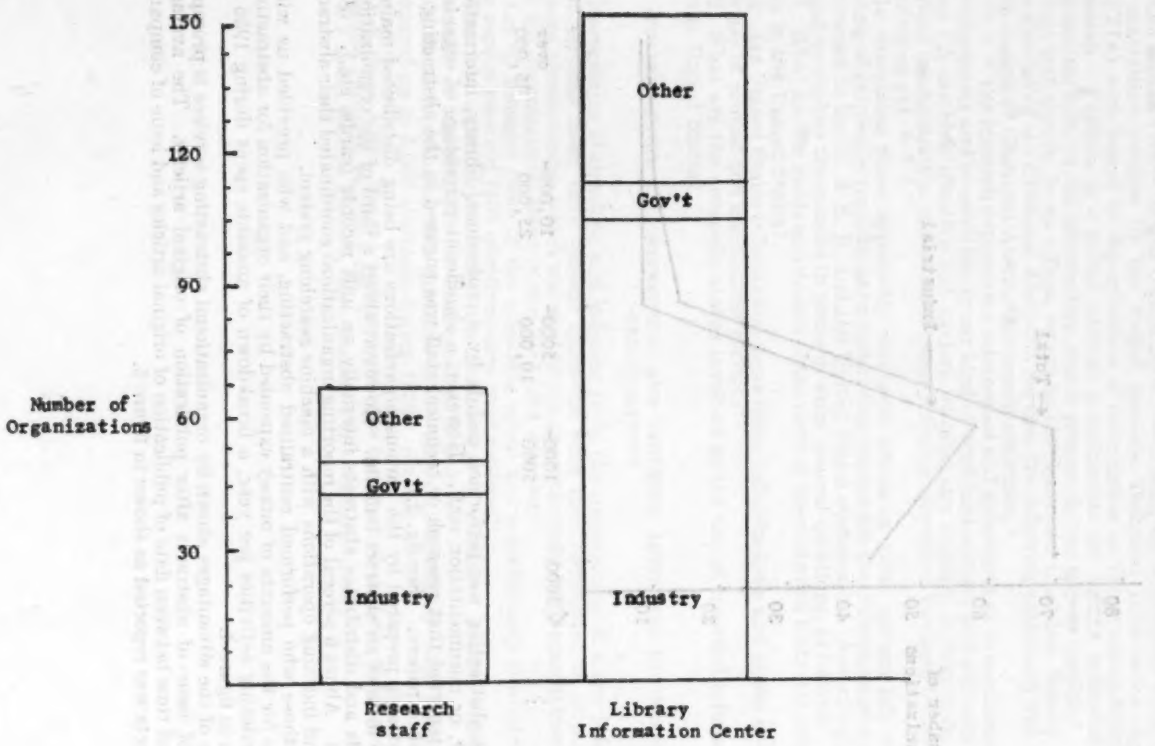


FIGURE 2.—Personnel engaged in abstracting.

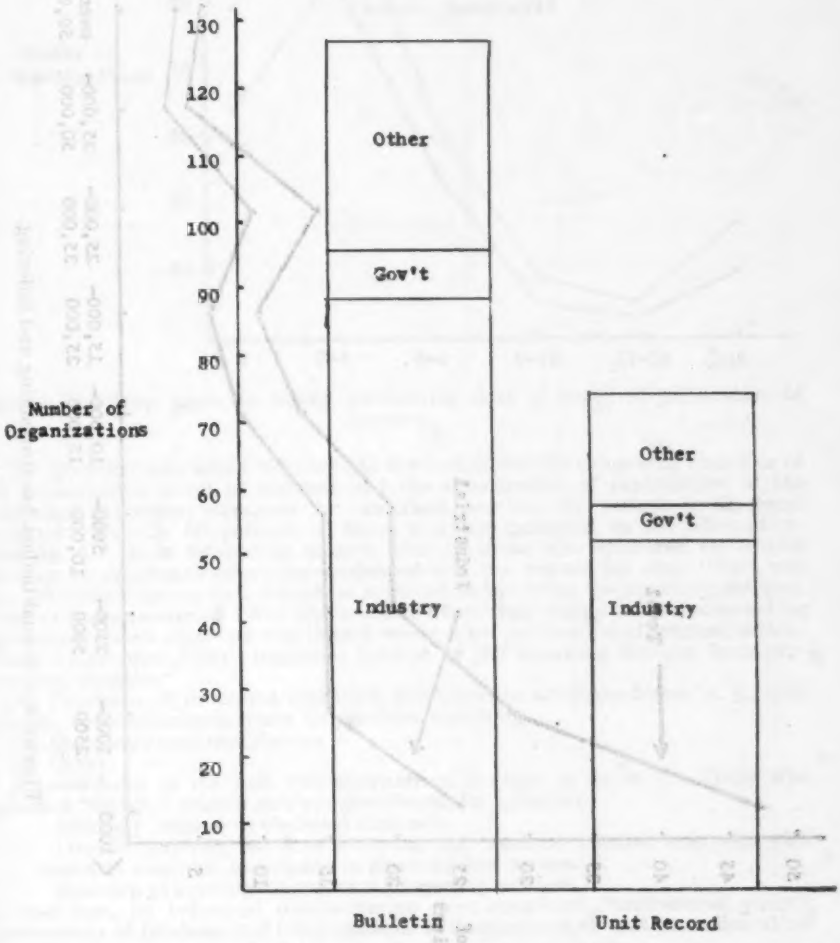


FIGURE 3.—Mediums for distribution of abstracts.

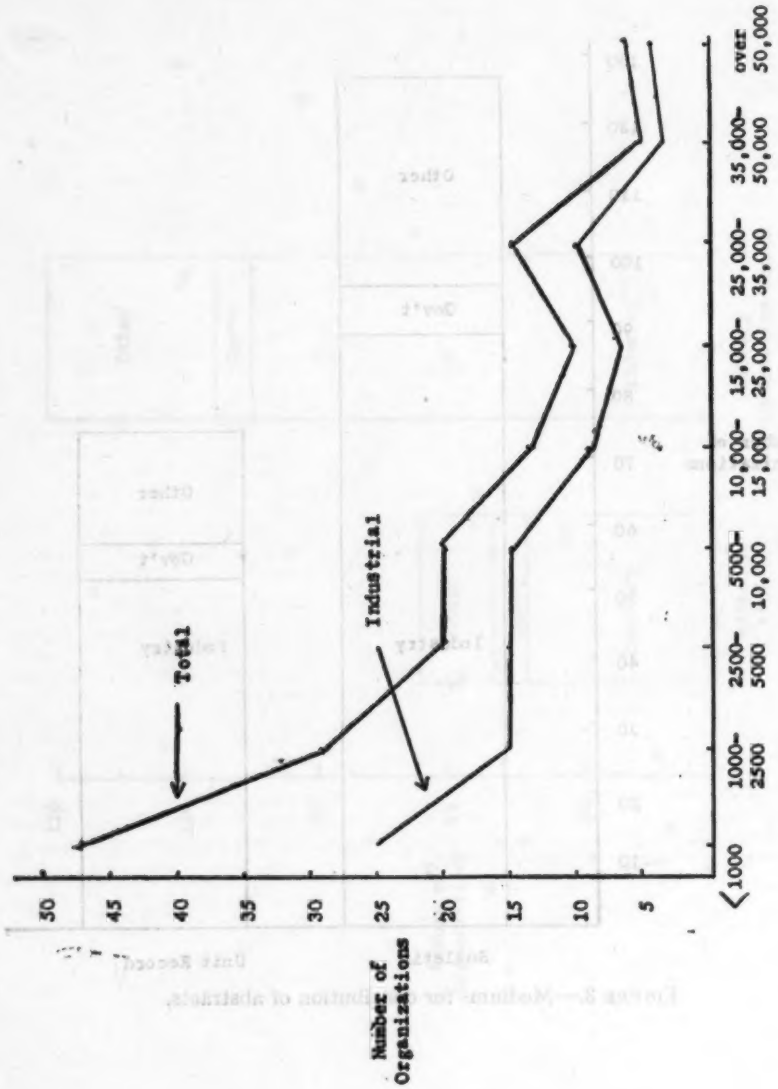


FIGURE 4.—Annual budget for abstracting and indexing.

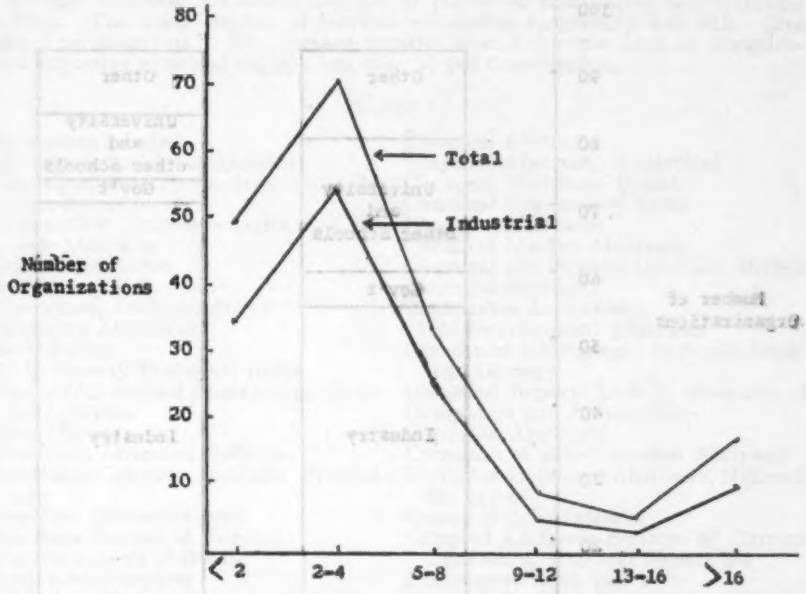


FIGURE 5.—Time lapse, in weeks, publication date of paper to publication of abstract.

The question was asked whether the internal literature processing expenses of the organization could be reduced and the effectiveness of exploitation of the published literature enhanced by auxiliary services by various professional societies. Exactly 50 percent of those replying indicated in the affirmative. (See fig. 6.) It is interesting to note that of those who answered no to this question, a significant percentage indicated that the reason for their "No" was the probable timelag that would be involved in receiving the auxiliary services. Most of those answering "No" also indicated that their organizational abstracting service published abstracts less than 2 weeks after publication of original article. Those who replied "Yes" indicated interest in the following services from professional societies:

(1) Provision of processed literature references in alternate forms, e. g., unit records, encoded records ready for machine searching.
(2) Question-answering service.
(3) Other.

A breakdown of the first two alternatives is given in figure 7. Those who specified "Other," desired services mentioned, for example:

Monthly indexes to chemical abstracts.

Overall indexing services covering the various natural sciences, with abstracts available on request in given subject ranges.

Speedup of existing information processing services.

In one case, an industrial representative even suggested "professional society sponsorship of fundamental investigations in documentation and communication problems."

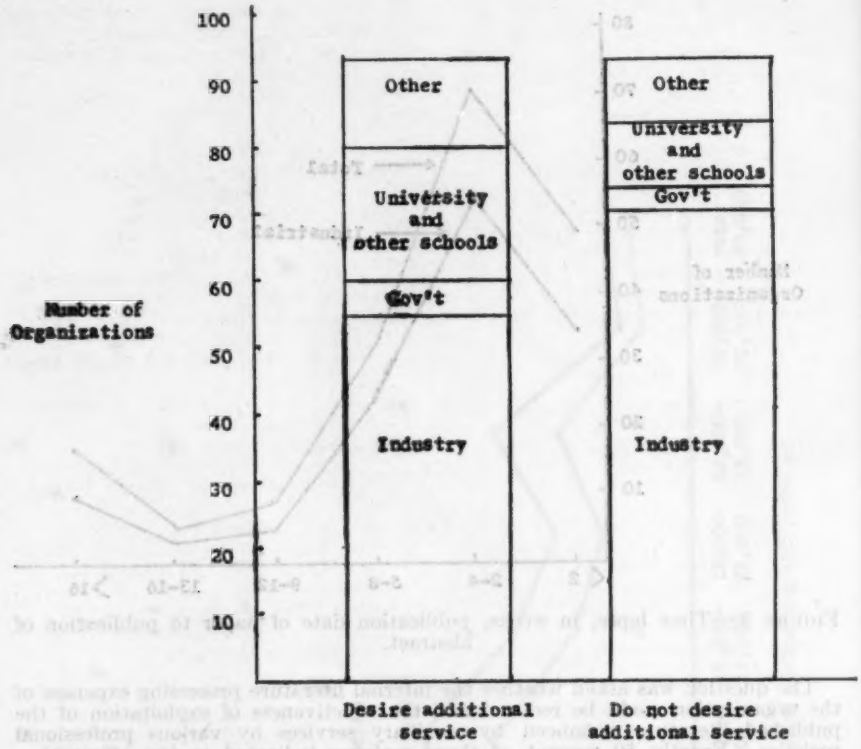


FIGURE 6.—Attitudes of individual organizations toward services of professional societies.

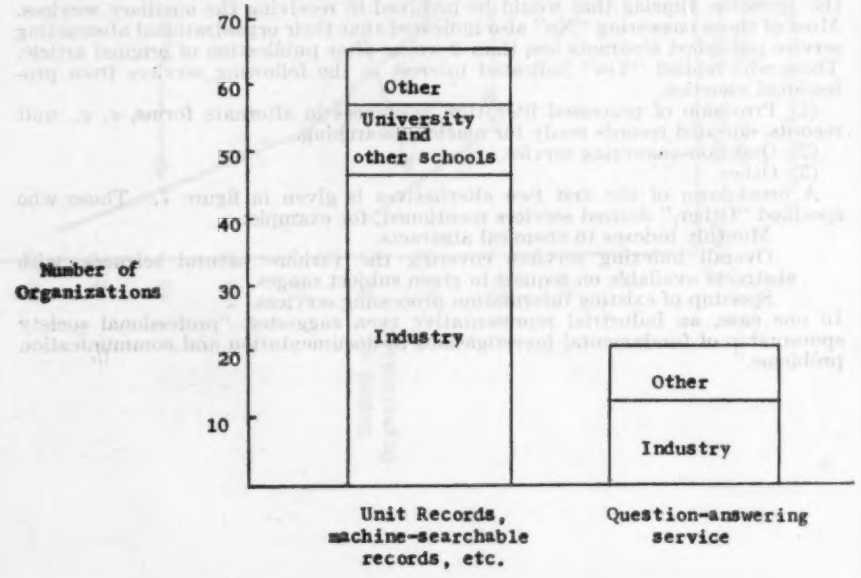


FIGURE 7.—Additional services desired from professional societies.

Another question concerned the use of published abstracting and indexing services. The total number of services mentioned specifically was 312. (See table I for examples.) The average number of such services used by organizations reporting averaged slightly less than 10 per organization.

TABLE I

Accountant's Index
Accoustical Society of America
Accoustical Society Contemporary Papers, Journal
Aeronautical Engineers Index and Review Abstracts
Aeronautics, Index
Agricultural Index
Agriculture, Bibliography of
Agronomy Abstracts
Air Pollution
Air University Periodical Index
Allergy and Applied Immunology, Quarterly Review
Alloy Digest
Aluminum Abstracts Bulletin
American Concrete Institute Proceedings
American Documentation
American Journal of Nursing
American News of Books
Analytical Abstracts
Analyticus Cancer, Index
Anco
Anesthesia and Analgesia Current Index
Animal Breeding
Annotated Bibliography of Economic Geology
API Technical Abstracts
Applied Chemical Abstracts, Journal
Applied Entomology, Review of
Applied Mechanical Review
Applied Physics, Journal of
Applied Spectroscopy
Art Index
Asian Studies, Journal of
ASTIA Card Service
ASTIA Unclassified Reports
Astronomical Newsletter
Atomic Energy Reporter
Battelle Technical Review
B. C. U. R. A. Bulletin
Best's Bulletin Service
Bibliographic Index
Biography Index
Biological Abstracts
Biological Science, International Abstracts of
Book Review, International
British Abstracts
B. S. E. A. Abstracts
Building Science Index
Business Service Checklist
Buttersworth Card System
Canada, Bibliography of
Canadian Index
Canadian Patent Office Record
Cancer Current Literature
Card Service, Advance Abstracts
Ceramic Abstracts
Ceramic Abstracts, British
Chemical Abstracts
Chemical Abstracts, Analytical
Chemical Abstracts, British
Chemical Engineering News
Chemical Literature
Chemical Market Abstracts
Chemical and Physics Abstracts, British
Chemical Spotlight
Chemisches Zentrablatt
Child Development Abstracts
Cinnotalid Bibliography of North American Geology
Classified Reports (ABC), Abstracts of
Computers and Automation
Corrosion Abstracts
Corrosion et anti-Corrosion Abstracts
Corrosion Engineers Abstracts, National Society of
Crerar Metal Abstracts
Crippled Children Bulletin of Current Literature, National Society for
Cumulative Book Index
Current Chemical Papers
Current Technical Literature, Index to
Dairy Science Abstracts
Data
Dental Abstracts
Dental Literature, Index to
Dirivent Patent Service
Dissertation Abstracts
Distillation Literature and Abstracts
Document Index
Dyers and Colourists, Journal Society
Eastman Kodak
Eastman Kodak Library Reports
Education Index
Electrical Engineering Abstracts
Electronics Abstracts
Engineering Index
Engineer's Digest
EPA Technical Digest
Essay and General Literature Index
European Technical Digest
Excerpta Medica
Fats, Oils, Detergents Abstracts
Field Crop
Files Coping the Technical News
Fisheries, Commercial, Abstracts
Fisheries Abstracts, FAO World
Food, Current Abstracts
Food Science Abstracts (British)
Food, Index and the Literature Journal of Food
Forestry Abstracts
Fuel Abstracts
Gas Abstracts
Gaylor's Technical Service
General Electric Internal Bulletins and Reports
Geological Abstracts
Geographical Publications, Current

Geophysical Abstracts
Glass Technical Abstracts, Journal Society
Government Classification Cards
Great Britain Department of Science and Industries Research, Translation of Russian
Herbage Abstracts
Highway Research Abstracts
Historical Abstracts
Horticultural Abstracts
Hosiery Abstracts
Hospital Abstract Service
Hospital Literature, Cummulated List of
Hospital Literature, Index to Current
Hygiene, Bulletin of
IGT Abstracts
IMM Abstracts
Industrial Arts Index
Industrial Diamond Bibliography
Industrial Health, Archives of
Industrial Hygiene Digest
Industrial Labs
Information Service Bulletin
Ink Maker
Instrument Society of America
International Index
International Institute for the Conservation of Museum Objects
Interplanetary, British
Iodine Abstracts and Reviews
IPC Library Notes
IRE Abstracts
Iron and Steel Institute Abstracts, Journal
Labor-Personnel Index
Lectrodex
Leukemia Abstracts
Library Bulletin of Abstracts
Library of Congress Air Pollution
Library of Congress Bibliography of Translation from Russian
Library of Congress, Books; Subjects
Library of Congress Central Europe Accession
Library Literature
Light Metals Bulletin
Literary Notes
Magnesium Review and Abstracts
Management Abstracts
Market Abstracts
Material Construction, Review of
Mathematical Abstracts
Medical Abstracts
Medical Digest, International
Medical Literature, Current List
Medical Science, International Abstracts of
Medical and Veterinarian Mycology, Review of
Medical and Veterinarian Zoology, Index-Catalog of
Medicus, Index
Medicine, Modern
Metal Finishing
Metal Literature, ASM Review
Metals Journal, Institute of
Metallurgical Abstracts
Metallurgical Abstracts (British)
Metals Review
Meteorological Abstracts
Military Affairs
Milk and Milk Products, Abstracts of Literature
Mond Nickel Bulletin
Monitor
National Defense
NACA Research Abstracts (card file)
Natural and Synthetic Fibers
Naval Research Laboratories
Neurology and Psychology, Digest of
New Testament Abstracts
New York Times Index
Non-Destructive Testing
Non-Ferrous Metals, British
Nuclear Science Abstracts
Nutrition Abstracts
Nutrition Reviews
NYSEM Bibliography of Electrical Microbes
Obstetrics and Gynecology Survey
Official Gazette of United States Patent Office
Olin Mathieson Chemical Corp.
Opthalmatic Abstracts and Research
Packaging Abstracts
Paint, Colour, Review of Current Literature relating to
Paint, Varnish and Lacquer Association, British
Paint, Varnish and Lacquer Association, National P. A. I. S.
Paper Chemists, Bulletin of the Institute
Paper Making and United States Patents, Bibliography of
Pasteur, Bulletin Institute
Patent Journal (Union of South Africa)
Patent Research Office Patent Lists, International
Patents Abstract Journal (British)
Pediatric Current Literature, Abstracts from
P. B. Reports, Index to
Personnel Administration
Personnel—Management Abstracts
Pesticides Abstracts
Petroleum, Journal of the Institute (abstract section)
Petroleum Technology
Philips Technical Review
Philippine Periodicals, Index to
Photographic Abstracts
Physics Abstracts
Plant Breeding Abstracts
Plant Disease Reporter
Plastics Fed, Abstracts, British
Plastics Technology
Poliomyelitis Current Literature
Prevention of Deterioration Abstracts
Printing and Lithographic Abstracts
Psychological Abstracts
Public Affairs Information Service Bulletin
Public Health Engineering Abstracts

Publisher's Weekly
Quality Control and Applied Statistics
Quality Control and Industrial Statistics Abstracts
Quarterly Cumulative Index Medicua
Radio Engineers, Institute of
Reader's Guide
Refrigeration Abstracts
Rehabilitation Literature
Report of NRL Progress
Research Information Service
Resins, Rubbers, Plastics
Revue d'Aluminum
Road Abstracts
Rubber Abstracts
Rubber Formulary
Russian Accessions, Monthly Accessions
Schnelidienst—Literature
Science Abstracts
Science Instrument Research Association, British
Science and Technical Papers, Abstracts of
Science and Technical Reports, Bibliography of
Semiconductor Electronics
SIPRE Bibliography
Socialogical Abstracts
Soil Science, Bibliography
Soils and Fertilizers
Solid Propellants
Special Library Consultants
Specifications and Rel. Pub. Air Force, Index of
Specifications and Standards, United States Army
Specifications and Standards, United States Navy
Spectrographic
Stanford Handbook
Statistical Methods in Industry, International Journal of
Subject Index to Periodicals
Subject Index to Periodicals, British
Sugar Industries Abstracts
Surgery, International Abstracts of
Surgical Digest, International
Surgery and Gynocology, Quarterly Review
Synthetic Liquid Fuel Abstracts
Synthetic Methods of Organic Chemistry (Theilheimer)
Tappi
Technical Abstracts
Technical Book Review Index
Technical Digest Service (new)
Technical Journals
Technical and Electrical Industries—File
Technical Reports
Technical Survey
Textile Industry, Journal of the
Textile Technical Digest
Textracts
Tobacco Abstracts
Toilet Goods Association
Translated Contents List of Russian Periodicals
Translation Monthly
Tropical Disease Bulletin
Tuberculosis Index and Abstracts
United Nations Documents Index
Uniterm Index of Chemical Patents
Universal Oil Products Abstracts
Unlisted Drugs
United States Bureau of Census Cataloging
United States Department of Commerce (Office of Technical Service)
United States Government Monthly Publication Catalog
United States Government Research Reports
United States Department of Agriculture Medical and Veterinarian Zoology
United States Department of Agriculture Soil-Water Conservation
United States Department of Agriculture Fish and Wildlife
Vacuum Abstracts
Veterinary Bulletin
Veterinarius Index
Vide
Vitamin Abstracts
Water Pollution Abstracts
Weed Investigation, Bibliography of
Welding, Bibliographical Bulletin for
Welding Journal, British
Welding and Metal Fabrication
Wilson Indexes
Wireless Engineers's Abstracts
Wistar Institute
World Medicine, Abstracts of
World Veterinary Abstracts Journal
Z. D. A. Abstracts
Zoological Record

NOTE.—The titles in this table were taken directly from the manuscript questionnaires returned to us. These entries have not as yet been verified for bibliographical accuracy. Verification will be completed prior to publication.

III. PROFESSIONAL SOCIETY QUESTIONNAIRE

In order to determine present abstracting and indexing practices by various professional and technical societies, a questionnaire was also sent to the executive secretaries of major professional societies in the United States. The replies from these societies have been slow in being returned, so that partial results only may be reported (60 questionnaires retured to date).

Some of the questions asked and a preliminary compilation of replies follows.

The first question concerned the publication or distribution of abstracts of published papers to the society membership:

Forty-eight percent published or otherwise distributed abstracts.

Another question concerned the form in which abstracts are issued:

Fifty-nine percent are published within a regularly issued technical or professional journal.

Twenty-eight percent are published as a separate abstract journal.

Three percent are issued on cards, slips, or other "unit records."

Forty-six percent of the organizations replying prepare indexes of published papers which are of potential interest to the membership or other subscribers.

Two percent maintain a translation service for their membership.

Most of the societies replaying were more reticent about divulging their abstracting and indexing budgets than the industrial organizations queried. Of these societies replying to this question, expenditures ranged as follows (see fig. 8):

Six percent, $100,000.

Six percent, $75,000 to $100,000.

Eleven percent, $50,000 to $74,999.

Sixteen percent, $25,000 to $49,999.

Six percent, $10,000 to $24,999.

Fifty-five percent, $10,000.

IV. CONCLUSIONS

What conclusions can be drawn from the results of the questionnaire?

By way of preface, let it be said that the results of the survey cannot be considered as definitive, but only as indicative. However, a number of observations may be made as follows:

1. The organizations representing users of professional information in the United States are spending significant amounts of money in order to process (abstract, index, digest) published literature on an individual basis for their own use.

2. A large percentage of literature-using organizations wishes to receive additional centralized and coordinated information-processing services from professional organizations. Their ability to pay for additional services is evidenced from their current information-processing expenditures, the additive total of which apparently exceeds by a wide margin the apparent expenditures of the professional societies for the same purposes.

Since a majority of the questionnaires to user organizations was directed to the special librarians, there is probably a significant amount of residual demand in the various organizations which was not reported by the special librarians. This residual demand relating to additional services was obvious from another previous survey directed to vice presidents of a group of companies, in which it was indicated that large percentages of professional people were dissatisfied with existing information services provided by the special librarian.

3. The fields covered in the centralized and coordinated information services at the U. S. S. R. represent virtually the same fields of interest indicated by those who replied to our questionnaire. In the United States, the tendency seems to have been in the direction of fragmenting the information services in many professional fields. This is evidenced from the significantly large number of services used by organizations here.

No further conclusions will be drawn from this paper, except to indicate that the economic drive for more effective utilization of recorded information is causing tremendous pressure for the development of a program of information processing which involves the proper balance between the activities of individual organizations and those of professional societies and government. What the proper balance may be is yet to be determined.

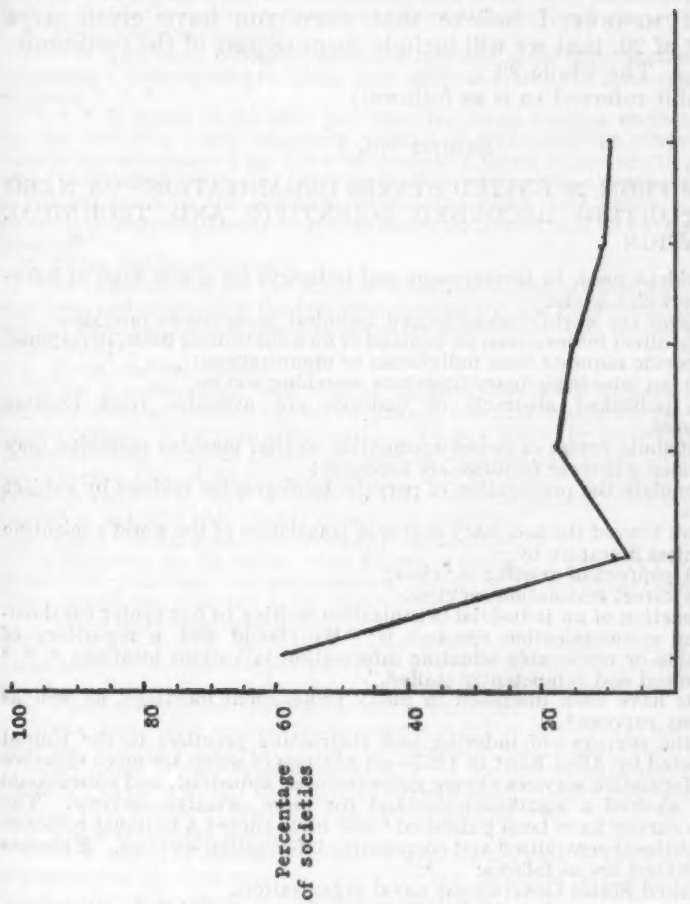


FIGURE 8.—Expenditures (in dollars) professional society budgets for abstracting and indexing services.

Dr. SHERA. In the process of making this survey, we accumulated a substantial quantity of statements from leaders in business and industry concerning the importance of this whole problem; and in exhibit No. 7 we have brought out 20—I think we had a total of something over 40—and we assembled 20 of those which seemed to us the most useful. Some of them—most of them, actually—are very strong statements.

I have marked in the copy here 3 or 4 which I thought particularly interesting. If you did not want to put the entire group into the record—at least those which I have marked in red could be read into the record.

Senator HUMPHREY. I believe that since you have given us a selective list of 20, that we will include them as part of the testimony.

Dr. SHERA. The whole 20.

(The exhibit referred to is as follows:)

EXHIBIT NO. 7

COMMENTS FROM 20 UNITED STATES ORGANIZATIONS ON NEED FOR EXPLOITING RECORDED SCIENTIFIC AND TECHNICAL INFORMATION

There is evident need, in Government and industry, for a new type of information service which would—

(1) exploit the world's scientific and technical literature to provide—

(*a*) direct information, on demand or on a continuing basis, in response to specific requests from individuals or organizations;

(*b*) an interdisciplinary literature searching service;

(*c*) published abstracts of material not available from existing agencies;

(2) distribute copies of coded information so that machine searching may be performed wherever facilities are available;

(3) stimulate the preparation of periodic bibliographic reviews by subject specialists;

(4) work toward the necessary degree of translation of the world's scientific and technical literature by—

(*a*) support of existing services;

(*b*) direct translation services.

A typical reaction of an industrial organization writing to our center for documentation and communication research is: "We should seek a repository of readily available or retrievable scientific information in various locations * * * highly mechanized and competently staffed."

These needs have been discussed in many professional meetings, as well as elicited in many surveys.[1]

In one of the surveys—of indexing and abstracting practices in the United States, conducted by Allen Kent in 1957—an analysis of needs for more effective centralized information services among governmental, industrial, and educational organizations showed a significant demand for more effective services. The results of this survey have been published [2] and have elicted a national response in favor of additional centralized and cooperative information services. Excerpts of 20 typical letters are as follows:

1. From United States Government naval organization:

"The 'large percentage of professional people' who are dissatisfied with present methods are, I believe, more numerous than many of us realize. For their own good, too many of them are like some of my patrons—they 'don't want to get the librarian in trouble' by complaining, and so we only find by accident that we are not satisfying them."

[1] A. Kent, Study of Centralized Information Services, report to National Science Foundation (Grant G–4105), December 31, 1957, to be published as a book in 1958.

[2] A. Kent. and R. E. Booth in Information Systems in Documentation, Interscience Publishers, New York, 1957.

2. From petroleum company:

"1. The paper is a good compilation of data on abstracting services or activities both here and in Russia. The sampling seems adequate enough to arrive at firm conclusions and for recommendations.

"2. There is a wide gulf between centralized abstracting and indexing services as shown by the comparison with individual company or organization. The service of a state-controlled organization must of necessity be more all inclusive than that of a company. The latter is fragmentary because of special fields of interest and the competitive nature of our industrial society. The latter is more wasteful of manpower because of duplication of effort.

"3. A comparison of the amount spent in Russia with that by industrial companies would probably be close. However, the comparison of personnel engaged in abstracting might not be comparable and could be a strong argument for a United States Government sponsored abstracting service."

3. From technical college:

"* * * You have, I believe, gathered together some very interesting statistics indicating a definite need for some more efficient method of achieving information retrieval * * *

"* * * It seems to me that you have furnished another statistical argument for the need of a vastly improved method of organizing the retrieval of human knowledge as published by the ever-increasing speed of our printing presses and other publication methods. This in itself is worthwhile, though it merely gives additional point to the problem without supplying any answer. As I understand your purpose, however, you intended no answer and so have achieved your purpose."

4. From metals laboratory:

"Your information on the Russian activities in the abstracting field is rather startling, and emphasizes the fact that, apparently, the English-speaking countries are not nearly as far advanced as are other countries in this matter as we like to think we are."

5. From medical college:

"What is a desperate need with all medical libraries is to have an up-to-date index of medical literature in all its phases, one that comes out on time and embraces articles of current appearance. We now have the Quarterly Cumulative Index Medicus, July to December 1954 [which] has just come off the press, and the Current List of Medical Literature which, though it appears monthly and fairly promptly, is very difficult to use, time consuming, and often is months behind in indexing quite easily obtainable journals."

6. From United States Government organizations:

"It frightens me to realize what Russia is doing. I just can't comprehend it. A brief 25 years ago, our manufactures (speaking of Chalmers, explicitly) found them almost too retarded to use their equipment."

7. From petroleum company:

"* * * information specialists must experiment widely and constantly, at great cost, to provide adequate services where complete abstracting and indexing is not possible within the company technical information section."

8. From mechanical manufacturing organization:

"Your paper with request for comments is before me. I was not in the hall to hear you present it, nor did I hear the discussion, which must have been lively.

"This paper is very interesting, indeed. I hesitate to make comments. What we ought to do is to call the paper to the attention of our Congressmen, with the request that sufficient funds be restored to ASTIA."

9. From petroleum company:

"* * * My only comment is that it appears that we in the United States are not receiving the best possible return for our technical information dollar; there seems to be much needless duplication of effort."

10. From pharmaceutical company:

"For other than the current material, a centralized abstracting service would, indeed, be a great boon to those of us who scan several services."

11. From pharmaceutical company:

"* * * It is a very well organized and presented work, and most revealing. It should serve as an impetus in correcting a situation of which we have all be long aware * * *"

12. From electrical manufacturing company:

"* * * The needs of industry, generally, are so diversified that, unless some systematized method is evolved, everyone will waste far more time in poring through information, which is either unnecessary or not of interest, than we do presently in going over the data from our existing sources of information * * *."

13. From United States Government engineering organization:

"A coordinated indexing and scientific program would be fine, if physically possible. With the present lack of trained personnel, and high costs, anything adequate seems like a pipedream. When this was discussed several years ago at a library institute at the University of Chicago, mechanical means were described as the only feasible ones."

14. From petroleum company:

"* * * I am inclined to think that the sampling is reasonably fair and that your conclusions are entirely justifiable.

"It has been a source of concern to me, ever since I heard the paper at the London Congress on the Documentation of Pure and Applied Chemistry, that the Russians obviously have found a way of doing what, in my opinion, should be done in this country to a greater extent, i. e., speed up their centralized abstracting. Sometimes I think we are unnecessarily seeking speed, merely as an expression of our national activist tendency to be 'doing something' rather than thinking. Howevet, I am convinced the conventional abstracting systems are too slow for optimum utility."

15. From petroleum company:

"* * * The individual cost of an immediate information service is very small compared to the loss of an opportunity or an idea in our competitive world."

16. From a university:

"As far as I can determine, it is a competent statement of the existing situation and lays the groundwork for affirmative measures in this area."

17. From manufacturing organization:

"The trend in the U. S. S. R. for centralized and mechanized dissemination of information is, on one hand, in accordance with the required centralization of scientific and industrial research, and, on the other hand, the mechanization, which is a daring enterprise, is naturally in conformity with the dynamic character of communism. It will be tried out, even if, later, it may prove unfeasible and be abandoned.

"On the contrary, there is no one in the United States to command the adoption of one method or another and, therefore, divergent opinions are expressed, and methods varying from field to field and from industry to industry are used.

"The application of mechanization to information retrieval on the largest possible scale is a venture that is worth trying if, after years of experiment, a foolproof system and a source giving a continuous flow of information is found. A new development usually meets with a certain amount of opposition, but the progress has been credited to those who have dared to disregard the negative evaluation in the early stage.

"The present fragmentation of dissemination of information results in duplications, overlapping, and gaps, in addition to diversity of presentation, depth, and range, so that the completeness of information varies, depending on the source."

18. From a paper company:

"It certainly points up the real and growing problem of research—to try to strike the happy medium between the centralized Russian system and the more individualized, miscellaneous methods employed in this country.

"I would suggest the value of a simplified abstract of this paper, distributed widely among industrial management. This might help explain some of the dissatisfaction with existing services provided by special librarians."

19. From a university:

"* * * A number of statements will be of vital interest to many of our scientists, especially a recording machine to search for material that might have appeared in the Chemical Abstracts in the past half century. When such a device is successful, the scientific and research institutions will certainly back any organization or company which would produce it."

20. From a public library:

"In the United States we already have a different framework from that in the U. S. S. R. Our abstracting is being done by professional groups and by individual organizations. I do not see how we could have one central abstracting center.

"A center for documentation, such as the one at Western Reserve University, can perform a service for abstracting organizations already in existence by exploring new and improved techniques. Maybe such a center could be something like a laboratory. The 'bugs' in numerous systems could be eliminated in the laboratory. The center could serve as a clearinghouse for information and an experimental laboratory in new and improved techniques."

From these reactions, it should be obvious that there is a strong and insistent demand for coordinated and centralized information services considerably beyond

that which is now available in the United States. Such services should be planned so as to provide an optimum balance between centralized and decentralized operations.

Dr. SHERA. I referred earlier to the fact that, in 1950, as an official representative of the United States, there was no definite organization in the United States to which I could turn to which I could report and get any constructive action regarding this problem of creating in the United States a central agency that would coordinate the various bibliographic activities that are going on throughout the country.

I think—again referring to Document No. 4—the article in the Federal Bar Journal states, more strongly than anything I could possibly say, the failure of existing Government agencies to carry out the mandates which the Congress has given them in this field.

However, before we were aware of this article in the Federal Bar Journal, we did prepare a statement, with appendixes by various representatives of four agencies, the Atomic Energy Commission, the Armed Services Technical Information Service, the Office of Technical Services of the Department of Commerce and the National Science Foundation—and, also the Patent Office.

The Patent Office, incidentally, is confronted, of course, with a tremendous problem, and, as I am sure some of you know there was a commission set up several years ago to see what could be done to expedite the process of patent searching. Subsequently, a Research Unit was set up in the Patent Office.

They are now working with the mechanization of patent information in the single field of steroids and have gotten truly astonishing results.

I think the Patent Office is the supreme example of what the Government could really do in this field if it buckles down to it, really takes the bull by the horns, so to speak, and really faces up to the situation. I think we can look to the Patent Office for real leadership in this field. I wish there were more agencies like it.

Senator HUMPHREY. We shall make a part of the record the testimony, your statement as exhibit 8 up to the appendixes, and we shall include the exhibits in appendix A, through D, as a part of the record by reference, noting in the testimony that these exhibits have been received and are available here in the committee files.

(The exhibit referred to is as follows:)

EXHIBIT NO. 8

SOME REACTIONS IN GOVERNMENT TO THE DEMAND FOR ADDITIONAL COORDINATED CENTRALIZED SERVICES

The continuance of our industrial and economic progress as well as the competitive situation vis-a-vis Soviet Russia require that our efficiency in scientific research and technical development shall not be permitted to decline. The rapid expansion in newly acquired knowledge no longer permits us to stand pat withs traditional methods of abstracting, indexing, and the like. One of the problem in introducing new methods is ignorance of their capabilities on the part of their users, i. e., on the part of scientists, engineers, etc. It is, in fact, not at all difficult, by means of surveys, questionnaires, and the like to develop evidence to support the point of view that the users of traditional information services are well satisfied. On the other hand, there can be no doubt that traditional methods often cannot, in a practically feasible manner, satisfy the more sophisticated and serious scientific and technical information needs of the United States, which are of key importance to the progress of research and development in this country.

It is gratifying to observe that a positive program to apply new methodology to information problems has already achieved important practical results in the United States Patent Office. Nearly 10 years ago, a management survey of Patent Office operations revealed a large fraction—estimated as high as 60 per-

cent—of the examiners' time in processing patent applications was being devoted to identifying those previously issued patents and other documents of pertinent interest to cases under consideration. Furthermore, this fraction of time devoted to searching increases as science and technology become more complex and the volume of recorded knowledge continues to expand. Preliminary experiments proved that automatic devices can be used to identify pertinent patents provided their subject contents have been analyzed and encoded in a careful, consistent fashion. More recently, the Patent Office has initiated operational searching of previously issued patents in an important field of medicinal chemistry. The advantages achieved have exceeded expectations. (See appendix A.) The improvement in the rate at which examiners can now process application in the field in question has turned out to be about five times the previous rate. As a consequence, the processing of an application and issuance of a patent is much less time consuming than formerly. Several patents in this field have been issued in a matter of weeks rather than years as before. The quality of the office actions—especially the ability to cite the most pertinent prior art—has been improved. The analysis and encoding of previously issued patents have enabled research laboratories to make much more effective use of information contained in previously issued patents for planning and conducting future research. In order to extend this capability to a broader range of information in the same field, the American Drug Manufacturers Association is arranging to apply the recently developed Patent Office methods to the scientific periodical literature in the same field. This cooperative effort between the drug industry and the Patent Office gives promise of increasing research efficiency, on the one hand, and expediting Patent Office operations, on the other hand. Budgetary savings are, of course, important but they appear likely to be overshadowed by a new stimulus to progress through research.

Regrettably, it is not possible to point to similarly successful and impressive applications of new information techniques on the part of other Government agencies. There has been, at best, only a limited degree of understanding as to what can be accomplished by information systems that are now technically feasible and under development. This failure has been prevalent even among trained librarians [1] as well as among persons untrained in documentation work but who have been assigned important national documentation problems.[2]

Even in cases where research in documentation has been supported, there has been prevalent a philosophy of backing preliminary research results before any evidence of value has been obtained.[3] This approach has, of course, led to confusion among serious research workers in the field of documentation research.[4]

The importance of achieving efficiency in the use of scientific and technical information is further attested by the establishment, under more or less direct

[1] The Atomic Energy Commission technical information program, although one of the better Government programs with regard to bibliographic control, has still not fully understood the potentialities of the newer developments, as evidenced by various published papers and public discussions by the chief of the Technical Library Branch, AEC. (See appendix B.) The analysis of various methods under development has been far short of imaginative with regard to what is possible in ultimate end use of the information available. Discussion with representatives of at least one of the major repositories of AEC information has shown almost total disregard for the problems of bibliographic control coupled with concentration of effort on the distribution of quantities of information.

[2] The program of the Armed Services Technical Information Agency has suffered in its implementation through incomplete and confused analysis of its function, as evidenced by various published papers and public discussions. (See appendix C.) In one of its research contracts it has been alleged that a high official in ASTIA was instrumental in placing a substantial contract with a profitmaking organization and then joined the firm in an executive capacity.

[3] An example in point is the premature self-congratulating assessment by the Director of OTS when the prototype of the rapid selector supported by his office was first announced. (See appendix D.) More careful examination of the philosophy of the rapid selector has since shown it to be merely an early step in research in this field and not warranting premature predictions as to value before adequate test.

[4] Various programs supported by the Office of Scientific Information of the National Science Foundation have been confusing to documentation workers. Examples are:

(*a*) In the fifth annual report of the National Science Foundation (pp. 79–80) it was predicted that the NSF supported study of the uses made of information sources and bibliographic tools by laboratory scientists was expected to produce information that will serve "as a guide in designing more extensive studies of this type. When more precise knowledge is available about the way in which scientists work with the literature and the effectiveness and shortcomings of existing bibliographic tools and services, a sound basis will have been built on which to plan improved services."

The report has been a disappointment, since it was predictable that this approach did not take into account the primary considerations of what newer services could offer. The nonexperts in documentation research who were polled could not be expected to provide the information desired.

(*b*) In the most recent, seventh annual report of NSF, as well as in later announcements, the projects in scientific information research (pp. 85–86) has not indicated promotion of main-line research in documentation in the United States, but rather a tendency—

(1) To support research in fragmentary aspects of the problem; and

(2) To support research groups in England when adequate facilities are available in the United States.

The basic, main line problems, have in general been ignored in the research grants.

Government sponsorship of various specialized information services in a wide range of acutely important fields. The following list is by no means exhaustive:

Advisory Group on Electron Tubes.
Advisory Group on Electronic Parts.
ANC–5 Committee.
Fuels and Lubricants—Coordination Research Council.
Electronic Components Index.
Forest Products Laboratories—ANC–17.
Forest Products Laboratories.—ANC–23.
Packaging Institute.
Infrared Information Agency.
Materials Advisory Board.
Solid Propellants Information Agency.
Radiation Effect Information Center.
Titanium Information Center.
Prevention of Deterioration Center.

It is not intended in imply that such specialized information centers do not provide valuable services—rather the contrary. As a consequence the pressures to provide needed information services are resulting in a trend toward expensive, ad hoc information organizations which are excessively costly. The benefits provided by such organizations could be achieved at much lower cost if they were coordinated with a broader program of cooperative and centralized information processing. Unnecessary expense could thus be spared both in establishing specialized information centers, when needed, and also in their operation.

(Appendixes A through D of the foregoing statement, listed below by title, will be found in the files of the subcommittee.)

APPENDIX A.—Progress Report on United States Patent Office Mechanized Searching, by Don D. Andrews, Director of Research and Development, United States Patent Office, presented for American Chemical Society, San Francisco, Calif., April 14–18, 1958

APPENDIX B.—Machines and Systems for the Modern Library. By Dr. I. A. Warheit, Chief, Technical Library Branch, Technical Information Services, United States Atomic Energy Commission, Washington, D. C. Paper presented before the Biological Sciences Division, May 28, 1957, at the SLA Annual Convention, Boston, Mass.

APPENDIX C.—ASTIA "Blue Sky." By Col. Franklin K. Fagan.

APPENDIX D.—The Rapid Selector—An Automatic Library. By John C. Green, Director, Office of Technical Services, United States Department of Commerce.

Senator HUMPHREY. Are you saying, Dr. Shera, that the work of the Patent Office—which, by the way, has been discussed somewhat in detail, I believe, in your staff report, Mr. Reynolds—that the work in the Patent Office proves that by some concentration of effort on the part of Government agencies considerable improvement can be made, and that already marked improvement insofar as the availability of data and information has been attained in the Patent Office?

Is that correct?

Dr. SHERA. Yes, it certainly is.

I cannot give the precise statistics.

Mr. Perry, do you have them?

Senator HUMPHREY. Mr. Perry, is that correct?

Mr. PERRY. Yes.

Senator HUMPHREY. Will you identify yourself for the record, please?

Mr. PERRY. James W. Perry, director of the center for documentation and communication research, Western Reserve University.

Senator HUMPHREY. Thank you.

Mr. PERRY. I had the pleasure of hearing Mr. Don Andrews, who is in charge of research for the Patent Office, present a paper at the recent meeting of the American Chemical Society in San Francisco:

Senator HUMPHREY. That paper is part of this.

Mr. PERRY. I might say, as part of this testimony, that the audience in San Francisco was deeply impressed, not to say astonished, by what the Patent Office has been able to achieve in improving their efficiency in processing patent applications.

Just one fact:

They are now completely up to date in this particular field of steroids and are able to provide Office actions in a matter of weeks where, previously, as I am sure you know, it was a matter of months.

Senator HUMPHREY. Senator O'Mahoney, I believe, is chairman of a subcommittee which has been checking into the operation of the Patent Office relating to the processing of applications and the dissemination and correlation of certain scientific information. You may recall that study.

Mr. PERRY. I don't know that I have seen that particular study myself. I am almost certain that I have not, as a matter of fact. I have followed the work of the Patent Office, by direct personal contact, since about 1946 or 1947, when I first began continuing discussions concerning problems in classification.

And, through the years, Patent Office representatives were on our American Chemical Society committee that was looking into the matter of scientific aids to literature searching.

More recently, we have had them on various American Chemical Society programs, presenting papers on various aspects of their work, which, incidentally, it should be noted, not only consists of a short-term program yielding immediate results in a specific field, but is also directed to a broader codification of organic compounds so that any given configuration of atoms can be detected by automatic means.

With this perhaps we begin to approach technical matters that may not be appropriate to mention here.

But I do want to indicate to you that there is more than one phase of this Patent Office research program, and we think they are going to come up with very useful results, especially from the long-range phase. The short-range is already demonstrated.

Senator HUMPHREY. Very good, sir. Mr. Reynolds had a statement.

Mr. REYNOLDS. I would like to observe that Herschel Clesner, who has been consulting with the staff and is author of Exhibit No. 4, submitted for the record by Dr. Shera, is a member of the staff of the Subcommittee on Patents, Trademarks and Copyrights, of which Senator O'Mahoney is chairman. He has been consulting with us from the beginning of this project. So we have the benefit of his advice and information that has been developed in that field.

Senator HUMPHREY. My observation relating to Senator O'Mahoney's subcommittee activities was directed primarily to the point that by the action of a congressional subcommittee there has been some stimulation of activity in the Patent Office. There has been close coordination and cooperation. I think it has been very helpful. We are hopeful that this will be contagious.

Go ahead, Dr. Shera.

Dr. SHERA. As you know, we had a meeting at Western Reserve in Cleveland in February of this year to try to get something started in this field. We believed, as I indicated earlier, that a geat deal of talk had gone on, a great many conferences have been held, and the time had come for action. We had tried repeatedly to get one of the

Government agencies to sponsor such a meeting but without success, so we proceeded to hold it on our own initiative.

We brought together some 150 to 175 people representing business, industry, the Federal Government, organizations now doing indexing and abstracting work, academic institutions, foundations, and others who we thought have a stake in this whole problem. The results of that conference were that a motion was adopted asking the National Research Council to make recommendations to the Government or to study the problem and recommend to the Government appropriate action so that something could be done.

I have here as exhibit 9 the statement of transmittal to the National Research Council, the action of that conference.

Senator HUMPHREY. We will note for the record exhibit No. 9, and include it by reference rather than by putting it in testimony. That will be subject to some reevaluation, may I suggest, in case we think it should be included in the record as a part of your testimony. It is a rather long documentation.

(The exhibit referred to will be found in the files of the subcommittee. Pertinent extracts, however, are shown on pp. 63–65.)

May I add, Dr. Shera, you have had a conference with Dr. Bronk on the subject; is that correct?

Dr. SHERA. Yes; material was submitted to him.

Senator HUMPHREY. The last time I saw you here in Washington you had been in conference with some of the Federal officials; is that not correct?

Dr. SHERA. Yes.

Senator HUMPHREY. Was it on that occasion that you made this presentation to the National Academy of Sciences?

Dr. SHERA. The presentation was not made orally, it was transmitted by mail with a covering letter.

(The letter referred to is as follows:)

WESTERN RESERVE UNIVERSITY,
Cleveland, Ohio, March 14, 1958.

Dr. DETLEV W. BRONK,
President, National Academy of Sciences,
Washington, D. C.

DEAR DR. BRONK: Following up on my letter of February 14, 1958, we are pleased to send you a formal petition from the Council on Documentation Research suggesting the appointment of a committee to study various pressing problems in the field of scientific documentation.

We would welcome an opportunity to visit you to discuss this petition in greater detail. We look forward to hearing from you at your early convenience.

Very truly yours,

JESSE H. SHERA,
Executive Secretary, Council on Documentation Research.

Senator HUMPHREY. I see.

Dr. SHERA. But there was no oral presentation of it.

Senator HUMPHREY. Have you had any response?

Dr. SHERA. We received an acknowledgment of it.

Senator HUMPHREY. Just an acknowledgment of its receipt?

Dr. SHERA. That is right.

Senator HUMPHREY. And you made the presentation, and you have been hopeful that——

Dr. SHERA. We have been hoping they would call a kind of hearing of some sort, but so far as we know—well, we do not know what has happened, to be perfectly frank.

Mr. REYNOLDS. I have discussed this matter on the telephone with Dr. Bronk. We will have at later hearings representatives from the National Academy of Sciences to present their approach to this problem.

Senator HUMPHREY. I would like to get from you, Dr. Shera, just what you had hoped might be accomplished by this presentation of yours, which is before us here as exhibit No. 9, to the National Academy of Sciences and the National Research Council? What had you hoped that they might do?

Dr. SHERA. The hope of the group was, let me make a slight distinction between the hope of the group and our hope——

Senator HUMPHREY. Now, the group represents whom and what?

Dr. SHERA. It does not represent anyone, really, it is just 150 people concerned about this problem who got together because we invited them to come to Western Reserve and talk about the problem. So the group has no corporate existence, no corporate authority.

Senator HUMPHREY. But the group, in other words, consists of people deeply interested in this whole subject matter of scientific literature?

Dr. SHERA. Right.

Senator HUMPHREY. And you held a conference at Western Reserve at which these 100 or 150 or more people were in attendance?

Dr. SHERA. That is correct.

Senator HUMPHREY. And from that group you made your presentation, or you gathered information for your presentation of documentation to the Academy of Sciences, right?

Dr. SHERA. Our whole purpose in calling the meeting was to present the problem to them and say, in effect what I have just said to you gentlemen here, that something must be done, we must take some kind of action. We have talked about this thing for 10 years, we must do something, and we wanted to bring together people that we thought were in a position to do something. That is, they were the representatives of foundations who had money to spend in this area, they were representatives of government who are concerned in this area, they are representatives of industry and business who might possibly have some of their research funds available, or at least who had an economic stake in this, and so on. But the object was to bring people together who could really do something and not just talk about the problem.

The result of the meeting was that they said this should be referred to the National Research Council for study and recommendation to the Congress. Now to me, personally, this was something of a disappointment because it seemed to me this again was sidetracking the thing.

I think the Congress should take leadership in this, but I do not think we should refer everything to the Congress. Every time someone wants something done they say "Let's go to Congress and get some money to do it." This was not our basic idea. Our basic idea was to try to develop out of this meeting a cooperative undertaking based on the American system of cooperation between Government and private individuals and groups to take some effective action on their own. Now this group had the power to do it, but again we are up against the same frustration that we have faced again, and again, and again: "Let's make a study, let's make a survey."

Senator LAUSCHE. Dr. Shera, in the correspondence that I had with President Millis of Western Reserve University last year, my recollection is that he wanted to call to the attention of appropriate Government officials the fact that Western Reserve University for some time had been doing the work which suddenly, because of sputnik, seemed to be in great demand in Congress and other places throughout the country. Will you tell the members of the committee for what period of time Western Reserve had been engaged in this type of work?

Dr. SHERA. Well, we have been engaged in this type of work and my colleagues here can correct me if my memory slips, ever since—well, they have actually been engaged in it since roughly——

Mr. PERRY. May I help you there?

Dr. SHERA. Yes; I wish you would.

Mr. PERRY. I think, Senator, we might distinguish between two things here. Western Reserve University is now the sponsor, if you will, of an organized effort that began I would say, around March 1955.

Dr. SHERA. Yes. So far as Western Reserve goes, right.

Mr. PERRY. Personally, I have been working in this area since November 1945—first at MIT. During the interim, November 1945 to March 1955, various other people have become associated with me in, may I say, a teamwork capacity.

For example, in 1951, as a result of the efforts of an American Chemical Society committee, we got out a book on punchcards.

Shortly after we arrived at Western Reserve University a series of papers which we had running at that time in American Documentation was finished and published as a book, Machine Literature Searching.

I direct attention to these items to indicate that Western Reserve's program has back of it a continuing effort on the part of myself and my associates.

Senator LAUSCHE. It was not the contemplation of the Western Reserve program that the Federal Government would be asked to undertake the coordination of this material that was felt needed?

Am I correct in that?

Mr. PERRY. May I have a crack at that one?

Dr. SHERA. I wish you would. That is a little difficult to answer.

Mr. PERRY. I think all of us recognize, as Dr. Shera has pointed out and was certainly evidenced at our meeting in February, that there are a number of organizations of which the American Chemical Society is one, the American Society for Testing Materials is another, that have devoted much effort to abstracting, indexing, and providing other information services.

It was our hope that this conference would serve to stimulate people to accelerate the development of more effective methods for making scientific information available.

It was not our thought that this should become primarily a Federal responsibility. Rather, speaking very bluntly, it was our opinion that if this were to be run as a monolithic Government program it would not be done as well, and it would cost a great deal more.

The alternative is a coordinated effort among those scientific, technical societies and certain Government agencies in areas where, for example, it is hardly appropriate for a private firm or non-Government organization to assume prime responsibility. It was our hope

that, with an understanding of the importance of this matter, these people could be brought together in a cooperative effort.

There is some reason for being optimistic in this connection: Late in January, in Philadelphia, the various abstracting agencies held a meeting and established a National Association of Scientific and Technical Abstracting Organizations. I may not have the title quite right, but that is what it means.

As far as their own individual efforts are concerned—and perhaps that is in the back of your mind, too——

Senator LAUSCHE. I think you have answered the question.

Mr. PERRY. All right. Fine.

Senator LAUSCHE. Now, out of this February 1958 meeting, there emerged a judgment of certain information which you assembled and conclusions which you reached that should be forwarded to the Federal Government?

Mr. PERRY. The National Academy of Sciences.

Senator LAUSCHE. That is right.

Mr. PERRY. It is not quite the Federal Government, as I understand it.

Senator LAUSCHE. That is correct.

Senator HUMPHREY. Then what do you expect the National Academy of Sciences to do with it?

Mr. PERRY. We outlined for discussion purposes a program looking toward a 10-year development in this field.

It was our best estimate that such a program, if carried through, would require an investment of approximately $36 million. The immediate effort would cost only a fraction of that amount, of course.

We thought what was immediately needed here—and we still think so—was a demonstration of what some of these newer electronic technics can accomplish in this field.

It was our best estimate that such a program can become self-supporting. Or, to say the same thing slightly differently, in this day and age the value of scientific and technical information to industry, to Government—if such information can be provided efficiently—is sufficient to provide an income which would support these more efficient, more effective services which we believe are necessary if we are to meet not only the Russian competition but, also, to provide the sort of basis that we need for our own continuing industrial and technical progress.

Senator HUMPHREY. Are you suggesting, therefore, that some of the funds that are required for this sort of coordinated effort, which would represent the cooperation of many agencies, both public and private, be made available from the Federal Government?

Mr. PERRY. It would perhaps work out that part of them would be from that source. I would hesitate to say that this is the only source, or that it necessarily should be the only source.

There are various industries that have a considerable stake in this matter: The American Society for Metals, to name one, has underwritten a research program in this field without in any way soliciting Federal support, so far as I am aware.

The Chemical Abstracts as far as I am aware has never solicited any Federal support. Dr. Crane could comment here better than I.

Also, the various foundations—the Carnegie Foundation might be mentioned—have indicated their interest in this area.

The Federal Government is not the only source of support.

Senator HUMPHREY. How do you get this coordination accomplished?

Let me just preface this by saying I am all for this whole idea of utilizing existing resources, existing agencies, existing law, existing initiative, both public and private. This makes a very good speech, and Americans just love to hear about it.

However, I want to know how you get it done; because what happens is that we get up here and praise how we are going to get all this coordination and how we are going to get all this cooperation, and then some fellow decides he needs a 3 weeks' vacation, and someone else decides he has information he does not think he is going to give anyone because it is a little advanced and he is not going to give it to them.

In the meantime, national security suffers and we wait for Sputnik No. 3, and everyone gets hysterical.

I am giving the picture as I see it; because I have heard a lot of talk about good government, freedom, free enterprise, and when it is all said and done, it does not work.

What I want to know is how to get it to work.

Mr. PERRY. Well, this is a difficult question.

Senator HUMPHREY. I am putting it directly to you.

Mr. PERRY. Quite so. I will be glad to comment on it.

There are several things to be said in this connection.

First, let me say this:

It is a difficult question, and I certainly do not consider that I or any other single person can be the source of all knowledge on that problem.

Next, there is already considerable evidence that people will work together in this area. I would submit for your attention what is accomplished at Chemical Abstracts in getting the chemical literature abstracted on practically a volunteer basis. So there is some reason for thinking that people will work together.

There are other pressures that are operative here: One of them is financial and economic.

Senator LAUSCHE. Mr. Chairman, might I say that the statement of the chairman contains thoughts which are not far separate from those expressed by the witness.

In the third paragraph of the statement, it is said:

> The subcommittee in holding these hearings is proceeding on the assumption that many private and industrial abstracting, translating, and research groups can provide most of this type of service to the Federal research programs and to scientists in our universities and industries without the necessity of establishing a scientific dissemination service under the control of the Federal Government.

Senator HUMPHREY. That I believe.

May I say to Senator Lausche, I do not want my question to be judged as if I necessarily am putting an affirmative value on the question.

I am asking you as a gadfly; I want to irritate you into an answer, you see.

Mr. PERRY. My friend, Mr. Kent, wants to talk, but let me say just one more thing in this connection:

If you look in almost any scientific or technical periodical which is published on a for-profit basis, you will find an abstracting section. You will have a hard time finding many such periodicals that do not

have abstracts. That is an observation you can check any time you wish.

Next, let me point out, that, to maintain their position, many scientific and technical societies and organizations of that type, provide abstracting and indexing services to their members. This is at considerable cost, and in fact in some cases the costs are hard for them to bear.

In other words, there is a certain economic pressure being exerted here toward doing something more effective, and one might hope that this pressure, in addition to developing and establishing more efficient services, would also tend to bring about cooperation. We hoped that the February meeting in Cleveland might contribute to developing mechanisms for cooperation.

Senator HUMPHREY. What I am trying to get at is that I am confident in my own mind that the utilization of existing resources is very vital and that they are doing a tremendous amount of work. I am convinced that there is a lot more being done than anyone knows is being done. In fact it is so fractured and so compartmentalized that the lines of communication do not even indicate a tabulation of the aggregate. Now what I was wondering is what kind of a mechanism do we ultimately seek to give further incentive to these private industrial and university groups, and the professional society groups, plus the government, both Federal, State and local? Some of this also goes on in the local public health service, or in the State governments, and some in Federal Government. How do we tie them in? That is what we are really getting at, isn't it?

Mr. KENT. May I comment on that?

Senator HUMPHREY. You are ——?

Mr. KENT. Allen Kent, associate director, Center for Documentation and Communication Research, Western Reserve University.

I do not believe all of the answers are available as to how these diverse operations might be tied together from a technical point of view. However, there are a number of research organizations operating in this field. We are one of them. To be immodest, we think we are one of the better ones in this area. We have ideas as to how this can be done. For the February 1958 meeting that we had at Western Reserve, we suggested, just to be the gadfly again, a $36 million program as a basis for discussion by the people who came there. When that program was referred to the National Academy of Sciences, we felt there was a lack of complete understanding on the part of various scientific and technical organizations and agencies of the Government of the United States as to what can be accomplished by the various new methods that are coming out of research in this area.

And again, to be the gadfly, I think you have in this Senate Document No. 90 an appendix indicating how we think a demonstration, a model, can be arranged to show how this might be done. There are other ideas as to how this might be done. Our idea is presented in the appendix of Document No. 90.

Senator HUMPHREY. That is what I wanted, and hoped for from this hearing. You have presented a plan, you have presented a model, you have presented an experimental trial run that you think, if initiated, might yield some positive results?

Mr. KENT. This is the case.

Mr. PERRY. Senator, I think it might be helpful to your committee if I were to read into the record a statement from a book entitled "Nomenclature of Organic Compounds" published by the Academy of Sciences of the U. S. S. R., commenting on the capabilities of contemporary technology to provide what they call a machine memory. May I include this in the record? It is relatively short.

Senator HUMPHREY. Yes.

Mr. PERRY. This will be exhibit No. 14.

(The exhibit referred to is as follows:)

EXHIBIT No. 14

Nomenclature of Organic Compounds, A. P. Terent'ev, A. N. Kost, A. M. Tsukerman, and V. M. Potapov, Izdatel'stvo Akademii Nauk, U. S. S. R., Moscow, 1955 (p. 107). Contemporary technology, by providing so-called machine memory, is able to be widely applied for storing and for classification of the colossal material which has been collected and published in the course of many years by chemical abstract journals. Contemporary electronic machines are able, in very short time interval, to select material needed for any question from the total accumulation of papers or abstracts stored by the machine memory. However, in order to store knowledge in the "memory" of the machine its preliminary encodification is necessary so that it may be represented in the form of a sum of well-defined sequential electronic or magnetic pulses. This means, for example, that it is necessary to represent the structural formula of an organic compound in the form of a linear sequential series of symbols whose combination does not generate ambiguities. (Translated by J. W. Perry.)

Senator HUMPHREY. Now we were referring earlier to exhibit No. 9, as I recall.

Mr. SHERA. That is correct.

Exhibit No. 10 is simply the proceedings of the February 1958 conference.

Exhibit No. 11 presents the proposed pilot project that Mr. Perry and Mr. Kent have been talking about.

And let me add one more word there. I think that if you could get a pilot operation really going, nothing succeeds like success. The very fact that such a thing was operating, and showing what could be done, would contribute greatly in getting cooperation in this undertaking. There are too many organizations sitting on the edge of their chairs, so to speak, waiting for someone to take the initiative. And if someone comes out strongly and says, "This is what we are going to do, maybe it won't work perfectly but we are going to try it," and if it does work, and I think it will, we are not going to have any trouble getting people to fall into line. I think they are just waiting for this initiative.

Senator HUMPHREY. We will make a part of the record that portion of exhibit No. 9, including the summary of the meeting held on February 3 and 4.

(The portion of exhibit No. 9 referred to is as follows:)

EXHIBIT No. 9

PETITION TO NATIONAL ACADEMY OF SCIENCES, NATIONAL RESEARCH COUNCIL FROM COUNCIL ON DOCUMENTATION RESEARCH

On instructions from the president of the Council on Documentation Research this petition is presented to the National Academy of Sciences with the request that a study program in the field of scientific documentation be initiated on a national basis for purposes of providing guidance to the various professional associations, industrial, and governmental organizations, academic and research institutions and foundations of the United States.

In particular, it was requested that the study program investigate—

(*a*) The advantages of more effective utilization of the world's recorded scientific and technical information.

(*b*) The selection of optimum methods for obtaining coordination of information processing activities.

(*c*) The financing of more sophisticated information retrieval systems.

This petition resulted from a meeting at Western Reserve University on February 3–4, 1958, of 158 representatives of professional societies, Government and industrial organizations, universities and colleges, and foundations and miscellaneous nonprofit organizations. The group met to consider a plan for the creation of a national center for the coordination of scientific and technical information.

The following supporting documents are enclosed:

(1) The working paper submitted to the conference registrants entitled "A Plan for the Creation of a National Center for the Coordination of Scientific and Technical Information."

(2) A summary of the February 3–4, 1958, meeting.

(3) Suggested study committee participants.

(4) A draft study program.

(5) Historical summary—Council on Documentation Research.

It is requested that other pertinent documents, sent with our letter of February 14, 1958, be considered as supporting documents for this petition:

(1) Proceedings of the January 16–18, 1956, meeting—Documentation in Action.

(2) Proceedings of the April 15–17, 1957, meeting—Information Systems in Documentation.

(3) Verbatim transcript of the February 3–4, 1958, meeting of the Council on Documentation Research.

(4) A list of registrants for the February 3–4, 1958, meeting.

It was requested that the results of this petition and of any resulting study program be reported to the representatives and observers of the meeting of the Council on Documentation Research. We wish to convey to you the urgency that the February 3–4 meeting felt in suggesting an effective study program that would lead to a coordinated attack on the problems facing all of us in dealing with recorded scientific and technical knowledge.

SUMMARY OF THE FEBRUARY 3–4, 1958, MEETING OF COUNCIL ON DOCUMENTATION RESEARCH

For a number of years, various members of the group which later became the Council on Documentation Research have been aware of the declining efficiency in the utilization of recorded scientific and technical knowledge in the United States. With the aim of promoting awareness of this problem and with the aim of raising the level of knowledge of new techniques and systems of information analysis, storage, and retrieval, a number of conferences were held in Cleveland and elsewhere. In the past several years, attempts were also made to direct the attention of the American scientific public to the extensive Soviet activities in information processing and retrieval. These Soviet activities, from published indications, have already laid the foundations for leaving the United States far behind in the effective utilization of the world's recorded scientific knowledge.

Research to develop radically improved methods for facilitating utilization of recorded knowledge had not been supported wholeheartedly in the United States. It was especially disturbing to observe indifference and complacency toward the mounting Soviet effort to apply automation procedures and electronic aids to solve problems in information retrieval and correlation. At Western Reserve University, frustration was felt particularly acutely when one of the Soviet papers reported that WRU methods were being studied in the All-Union Institute of Scientific Information in Moscow.

Discussions with various Washington officials revealed a state of confusion or resentment because of pressure to coordinate better United States coverage and use of scientific information. Especially disturbing was the thought that responsible agencies were not in realistic contact with scientific information user needs and were devoting attention mainly to information processor problems.

In weighting the probable lack of effective actions likely to be taken by existing agencies, the Council on Documentation Research decided to call a national meeting at Western Reserve University to work rapidly toward necessary action in coordinating scientific and technical information to meet modern requirements and to provide a foundation for further progress.

In order to insure that concrete suggestions for progress would be considered, the School of Library Science and its center for documentation and communication research distributed a working paper to all registrants in advance of the meeting. The "plan for the creation of a national center for the coordination of scientific and technical information" represented a suggested method of attack on the problem based on recent research, some published and much unpublished, which is going forward at several centers, one of which is Western Reserve University. Other proposals were made with regard to centralized information services. One of these came from Standorrd Research Institute.

The meeting was organized as three sessions:

(1) Statements of projected needs and present status.

(2) A proposed program for national coordinated control of scientific and technical information.

(3) Discussion.

(1) Statements of projected needs varied considerably as was anticipated. The users of recorded scientific knowledge reflected unusual urgency for bold and courageous action to provide relief to their problems of making effective use of the literature. On the other hand, the representatives of agencies that process scientific information, with few exceptions, reflected relative complacency with little inclination toward attempting major advances in services or methods.

(2) A proposed program, as presented for discuisson by Western Reserve University, outlined the need for a new type of information service which would—

(i) Exploit the world's scientific and technical literature to provide—

(*a*) direct information, on demand or on a continuing basis, in response to specific requests from individuals or organizations;

(*b*) an interdisciplinary literature searching service;

(*c*) published abstracts of material not available from existing agencies.

(ii) Distribute copies of coded information so that machine searching may be performed wherever facilities are available;

(iii) Stimulate the preparation of periodic bibliographic reviews by subject specialists;

(iv) Work toward the necessary degree of translation of the world's scientific and technical literature by—

(*a*) support of existing services;

(*b*) direct translation services.

The plan called for a balance between centralized and decentralized activity so that there would be—

Moderate decentralization with regard to processing of information for retrieval and communication.

A combination of centralized and decentralized activity in conducting retrieval and correlating activities.

Moderate centralization with regard to the use of information from the various disciplines in order to promote interdisciplinary search and correlation.

More specifically, it was proposed that the processing (abstracting, indexing, encoding) of scientific information be conducted on a coordinated basis by various scientific and technical societies and similar organizations. Retrieval and correlation of processed information could then be accomplished locally at larger research centers, and, also, regionally or centrally. The degree of centralization would be strongly influenced, on the one hand, by the nature of information requests and, on the other hand, by the range of information which would be kept available at a local, regional, or central service. Economic factors would need to be carefully weighed in arriving at decisions as to centralized and decentralized activities. It seems likely that certain activities might be initiated on a centralized basis and subsequently decentralized to achieve greater efficiency and flexibility.

(3) The discussion was lively and lengthy: highlights are given in table I. Comments ranged from a direct condemnation of existing agencies that have had major responsibilities in this field and that have not taken the initiative, to complacency with the status quo. In the main, the consensus of the meeting was that a crash study program be initiated to investigate—

(*a*) the advantage of more effective utilization of the world's recorded scientific information;

(*b*) selection of optimum methods for obtaining coordination of information-processing activities; and

(*c*) financing of more sophisticated information-retrieval systems.

(Documents placed in the record by direction of the chairman are as follows:)

WESTERN RESERVE UNIVERSITY,
Cleveland, Ohio, May 16, 1958.

Mr. WALTER REYNOLDS,
Staff Director, Committee on Government Operations,
United States Senate, Senate Office Building,
Washington, D. C.

DEAR MR. REYNOLDS: We are enclosing a letter received today from Detlev W. Bronk, president of the National Academy of Sciences-National Research Council, officially informing us of the action taken by the Academy with regard to the proposal submitted by the Council on Documentation Research.

We have called a meeting of the executive committee of this Council, to be held at the Lehigh University Library, Bethlehem, Pa., at 10 a. m. on Monday, June 2. The purpose of this meeting will be to define the role of the Council in the various national documentation programs now being initiated.

At this time, when far-reaching policy decisions are being made, it is particularly important that effective liaison be maintained between your committee and the Council. We therefore think it highly desirable that you consider designating someone (from your staff or from the committee) to participate in this meeting at Lehigh.

Very truly yours,

JESSE H. SHERA,
Secretary, Council on Documentation Research.

P. S. We hope of course, that you yourself, can come.

J. H. S.

NATIONAL ACADEMY OF SCIENCES,
NATIONAL RESEARCH COUNCIL,
Washington, D. C., May 14, 1958.

Dean JESSE H. SHERA,
School of Library Science,
Western Reserve University, Cleveland, Ohio.

DEAR DR. SHERA: In response to your letter of May 12 I am glad to advise you that on April 27, 1958, the Governing Board of the Academy Research Council approved recommendations that emerged from discussions at the National Research Council meeting on March 31 and April 1 of the request addressed to us by the Council on Documentation Research.

Under these recommendations we expect to establish an Advisory Board on Information and Documentation in Science with members of high competence, including both scientists and information specialists, to prepare a plan for effective action on the problem. This Board would have a small fulltime professional staff to assist it in carrying out its study. The functions of the Board would include the following:

1. To scrutinize the national and international problems in this field on a general policy level.
2. To make a survey and assessment of the knowledge now available and of the work in progress.
3. To prepare a plan for the coordination, by appropriate agencies, of the many activities now being carried on in this field under the auspices of the Academy Research Council and elsewhere in the country.
4. To address itself to certain concrete and immediate problems, including assistance to the Office of Scientific Information of the National Science Foundation, the assessment of proposals for research undertakings, the identification of areas where new knowledge is needed, etc.
5. To effect liaison in its study among the several committees and groups now studying the problem, including the Committee on Information in the office of Dr. James R. Killian, Assistant to the President for Science and Technology, the Federation of Abstracting and Indexing Services, etc.
6. To prepare a plan for an information center on the subject of information and documentation in science.

We plan to proceed along these lines in the near future, and we shall be very glad to have the assistance and advice of the Council on Documentation Research.

Sincerely yours,

DETLEV W. BRONK, *President.*

Senator HUMPHREY. We will make part of the record, by reference exhibit No. 10, entitled "Plan for the coordination of Scientific and Technical Information," and exhibit No. 11, entitled "Need for Model Exploitation Center."

(The exhibits referred to will be found in the files of the subcommittee.)

We are privileged to have this morning a number of visitors from abroad who are professional people here in the United States on special study missions. They inquired some time ago as to whether or not they might not be privileged to attend one of the Senate committee meetings, and we considered it an honor and a privilege to have them do so. We want to welcome them, on behalf of the United States Senate. I gather that we have representatives here from many countries. This makes us all the happier.

So that they may know what we are doing, we are discussing some of the possibilities in the field of coordination, dissemination, documentation of scientific data. We are hearing testimony from representatives of one of our great universities, Western Reserve University, of the great State of Ohio.

The State of Ohio is ably and brilliantly represented here by its Senator Lausche, one of its two Senators.

Senator LAUSCHE. May I put a question that I think is pertinent?

I am reading from the first page of exhibit No. 9, and it reads:

> On instructions from the president of the Council on Documentation Research, this petition is presented to the National Academy of Sciences with the request that a study program in the field of scientific documentation be initiated on a national basis for purposes of providing guidance to the various professional associations, industrial and governmental organizations, academic and research institutions, and foundations of the United States.
>
> In particular, it was requested that the study program investigate—
>
> (*a*) the advantages of more effective utilization of the world's recorded scientific and technical information;
>
> (*b*) the selection of optimum methods for obtaining coordination of information-processing activities; and
>
> (*c*) the financing of more sophisticated information-retrieval systems.

Now, Dr. Shera, is it No. 1 and No. 2 of these suggestions which you believe have been adequately explored, and that action is now necessary on the basis of those explorations?

Dr. SHERA. Yes. That is a good question. I would say the first has been pretty thoroughly investigated. The second is in the process of investigation.

We have this study underway at Western Reserve. That is the exploration of optimum methods for obtaining coordination of information-processing activities.

So what we need now, I think—again, going back to exhibit No. 11—is this pilot operation which would explore these new techniques, new methods, in an effort to determine and to demonstrate just what can be done.

Now, it may be necessary for the Federal Government to take leadership in this. I rather think it may be. And I think this is a proper role for the Federal Government; to take leadership.

But, again, let me say that I think that, once this step is taken, once people can see some action instead of this incessant talk, then we are going to get cooperation.

There was one thing in your reading, Senator, that reminded me of something that I had inadvertently omitted. You mentioned the Council on Documentation Research.

This, again, is a voluntary group of some 30 or 35 organizations interested in this field. It has no corporate existence. It has no constitution or bylaws. These are people who have met together at Western Reserve and elsewhere to try to do something about this problem. It was under their auspices that this meeting in February, which we are talking about, was held.

Again, I think that the very existence of this group indicates the readiness of many organizations to cooperate in a program of this kind, if someone will just get busy and push it.

Senator MARTIN. May I ask a question?

Senator HUMPHREY. Senator Martin.

Senator MARTIN. On that same page where Senator Lausche read, down toward the bottom of the page, you have a statement that—

> The group met to consider a plan for the creation of a national center for th coordination of scientific and technical information.

Would that express your views, if we were to insert the word "voluntary" ahead of the word "coordination"?

Dr. SHERA. Yes; I think it would.

Senator MARTIN. Would not that clarify some of the points that we have been discussing here, as to how far you want to go?

Dr. SHERA. Yes; we thought of it as voluntary. Again, we are not copying the Russians.

Senator MARTIN. That would remove some of the question there, I think, if we just inserted the word "voluntary" ahead of the word "coordination."

Dr. SHERA. It would certainly be agreeable to me.

I am sure we had no other thought in mind.

Senator MARTIN. I am sure that what you had in mind was a completely voluntary approach to it, and I thought perhaps it would clarify things if we put the word "voluntary" in there.

Does that meet with your approval?

Dr. SHERA. It certainly does.

Mr. Perry raises a legal question here, which is quite right. The statement under consideration was, of course, the action of the group—the Council on Documentation Research.

We at Western Reserve cannot change the wording—but I do not think I am stretching the point to say that I think that the feeling of the group was it was voluntary.

Certainly I do not recall anyone suggesting any kind of compulsory sort of agency.

I cannot believe that the group—the Council on Documentation Research—would object to this. On the other hand, of course, I have no right really to change it.

Senator MARTIN. I will not ask you to change it.

I thought perhaps the suggestion might meet with your personal approval. We won't change the prepared statement.

Dr. SHERA. I am as sure of it as I can be.

Senator MARTIN. I just wanted to have your personal opinion on that matter.

Dr. SHERA. Of course, "cooperation" to me—and in this, of course, I may be typical—means voluntary action. Otherwise, it is not cooperation; it is compulsion.

Senator MARTIN. The word here is "coordination" and not "cooperation."

Dr. SHERA. I am sorry. That takes care of that.

Senator MARTIN. That is why I wanted "voluntary" put in here.

Senator HUMPHREY. We have three alternatives here.

To just go ahead as we are—which is needlessly coming in second in a two-man race. Or we can try to improve it through a better system of coordination and cooperation. Or, we could establish a great national office, in which a full bibliography of all scientific data would be maintained and in which documentation, dissemination, et cetera, would all be done under Federal power of Federal operation, as a National Government operation.

Do I understand that what you are recommending in the broad outline here is, No. 1, what we are presently doing is not adequate?

Dr. SHERA. Right.

Senator HUMPHREY. Are we agreed on that?

Dr. SHERA. That is correct.

Senator HUMPHREY. Secondly, that you do not recommend the establishment of a Federal primary activity, I mean, an activity on the part of the Federal Government to handle all this material through a Federal agency?

Dr. SHERA. That is correct.

Senator HUMPHREY. You do recommend, in other words, the second alternative, where the Federal Government might serve in a coordinating or leadership role?

Dr. SHERA. Exactly. You state it very well.

Senator HUMPHREY. To gain greater participation and cooperation and coordination by private, nonprofit, educational, industrial, State, local, and professional services.

Is that correct?

Mr. PERRY. With one qualification.

Senator HUMPHREY. What is the qualification?

Mr. PERRY. The qualification that if the cooperation or the coordination cannot be obtained voluntarily, then the problem is of such importance that Federal action is necessary.

Senator HUMPHREY. You see, we want to pinpoint this down, because I think we are talking about something that is not an academic subject here. I want to say, very frankly, we are all deeply indebted to our great universities for their tremendous contributions to national security.

But I am of the view that we are talking about the life of the Nation.

Dr. SHERA. Right.

Senator HUMPHREY. And I am not ready to leave that in the hands of a mail-order company. So I am trying to find out whether or not we can get this program worked out so it is accomplished within the framework of a cooperative enterprise, in the sense where we get groups to work together.

But in order to do that, there must be someone who is the leader.

Dr. SHERA. That is right.

Senator HUMPHREY. This country is short on this idea that someone is going to take the lead. They have a simple idea you are going to turn everyone out to pasture and see who is going to hit the fence first. I want to know, as someone once said, "Who is running the store." Because this is what is wrong in the Nation. You do not run a university without someone in charge, you do not run a department without someone in charge. You do not even run your Senate without someone in charge, do you?

Mr. PERRY. No, sir, you certainly do not.

Senator HUMPHREY. So what I want to know is who is going to be in charge, whom are you recommending?

Mr. PERRY. I think inevitably, because of the importance, this has to be the kind of committee that is outlined in your bill here.

Senator HUMPHREY. Yes.

Mr. PERRY. This is a matter of such importance to the national welfare that the ultimate authority on this has to be the sort of committee of which you are a member.

Senator HUMPHREY. The purpose of my getting to you on this is to draw you out just a little bit more, because we respect your views.

Mr. PERRY. I am sure you know and understand the mechanisms by which such a committee can make the will of the people known. For me to attempt to outline such mechanisms would be at least presumptuous, and perhaps ridiculous. I am not that skilled in Government matters.

Senator MARTIN. At this point you are hopeful that you do not have to resort to that concentration of authority to make the whole program compulsory? You are hoping that the system will work on a voluntary basis?

Mr. PERRY. It will work more efficiently—a better job at lower cost.

Senator MARTIN. With the assistance of the Federal Government in setting up the mechanics of the clearinghouse and its function on a voluntary basis. And if that is not possible, if we have to go beyond that, that is quite another approach, quite another development. At this point you are not advocating that last step?

Mr. KENT. Not until it has been demonstrated that the other way cannot work.

Senator MARTIN. It would be well for us at this hearing, at this point, to confine ourselves to the first approach and not undertake too big a bite at this point of our proceedings.

Mr. PERRY. There are some areas of, say, military technology, where the very nature of the subject matter makes it necessary that the effort shall be Government supported, Government controlled, Government administered.

Senator MARTIN. Yes, we are not trying to form a system here that will run roughshod over those principles that have already been established in the military field in the study we are making here. We are not trying to tear down any program that is run along that line now, nor are we trying to join it in general for all in the field. At this point we are trying to bring about a voluntary coordination, and help that by setting up a system such as you advocate here, for a clearinghouse with government assistance, without that compulsory feature being added, or reduce the compulsory feature where it now exists. Is that correct?

Mr. PERRY. That is correct.

Senator HUMPHREY. I have just been discussing with Mr. Reynolds here what specific things might be done. I also understand, of course, the position of Senator Martin, about the desirability of not having some superimposed office or bureau or agency on top of everything we already have.

Is that your feeling?

Dr. SHERA. Yes, there is no question about it.

Senator HUMPHREY. We already have all the laws on the books, we have enough law here to take care of six countries already, not just one. We can export some if someone needs them. We have laws granting broad authority in this field to the Patent Office, the Department of Commerce, the Atomic Energy Commission, the National Science Foundation, and other agencies. We have all kinds of authority for correlation, dissemination, translation, printing, and so forth, scientific data—it is all here. In fact, it is all over the lot.

Now how do you bring all these children back home so that they start acting like a family and we get to converse with each other once in a while?

Mr. KENT. We would certainly like to know this.

Senator HUMPHREY. That is what we want you to help us do.

Mr. PERRY. Our contribution will probably be mainly in the area of techniques, methods, procedures, and also equipment.

On the organization and administrative side, speaking for myself alone, I think it would be presumptious for me to try to tell you how to do this. Our contribution, however, can be decisively important, I believe, with regard to methods, procedures, techniques, equipment, and we believe that the sort of thing we can demonstrate on an operational pilot scale would be very useful in this connection.

Senator LAUSCHE. I gather from what has been said by you three representatives of Western Reserve University you are of the opinion that there should be established in the Central Government an agency that will operate as a stimulant in inducing all of these private agencies engaged in this work to collaborate toward the end that you have in mind.

Mr. KENT. That sounds like a very good statement. This is the closest I think we have come to a statement of what we have in mind.

Senator LAUSCHE. That is, you don't want the Federal Government to undertake the actual ministerial work in distributing this information.

Mr. KENT. Unless it is not done by others.

Senator LAUSCHE. Unless it is knocked out by others through their unwillingness to cooperate in response to a stimulant that a Secretary of Scientific Information will bring to bear upon it.

Dr. SHERA. Quite so.

Senator MARTIN. Will you add to that that we'll cross that last bridge when we get to it?

Senator LAUSCHE. I think so; that is correct.

Senator HUMPHREY. That is a very good statement. What I was trying to get at earlier was, in the bill and the staff report we have noted there are a host of activities on the part of the Federal Government in the field of scientific research and in the field of dissemination of scientific data, translation, documentation, bibliographies. We have all the information; we don't need to get that. The real trouble is that every agency is living by itself, as it were. We have the

Patent Office, the National Science Foundation, the Office of Technical Services, and different agencies of Government that have some of this material and, in a sense, are gathering it on an autonomous basis, often duplication of the same material. Also you have these great scientific societies, the great universities. There are tremendous resources in this country. We are like a giant, except that we have schizo-compounded. Whether we like it or not, we are competing with a country that is a monolithic structure.

A very great official in steel, once said we never need to worry about the Soviet Union when it comes to steel. They only produce about 40 million tons, and we produce about 120 million tons. Later, the Soviet Government got up to producing 60 million tons, and we were still producing only 125. The trouble is, they can use this steel for all the things that they want to. We are still producing 125 million tons. We are working at less than full capacity, and we still insist on yo-yos and bathtubs and refrigerators and cars, while they insist on missiles and rockets. Now, don't misunderstand me. I like our way better, provided that we can live—provided they don't throw all that steel at us.

This is Senator Martin's comment, that we'll wait and cross that bridge when we get to it. Fine, provided they don't blow the bridge up before we get there.

What we are trying to determine is what shall we do, specifically, in order to harness these resources? There's no sense in talking about the fertility of fields if a man never plows those fields. There is no need to talk about what we can do with our great strength and resources if we never apply it. I like the idea that was just suggested, that maybe we need to have some kind of a cooperative, or a central cooperative head here to get the most out of what we have.

Mr. KENT. What we need is a club to be able to use when necessary.

Mr. PERRY. There are two separate considerations here that I think should be kept in mind as separate considerations. One is what I might call the organizational administrative problem area, which pertains to getting people to cooperate to coordinate their efforts. The other area is the technological area which pertains to methods, procedures, and so on, relating to abstracting, to indexing, to the correlation of information, and in particular to the application of modern electronic methods. This second area is where I believe that our group at Western Reserve can make the major contribution.

As far as the first area, the administrative, the organizational, that is, I submit, by virtue of its importance the responsibility of you gentlemen in the Congress.

Senator HUMPHREY. I see that you once suggested the proposing of a National Institute of Documentation in your memorandum to the Senate Committee on Government Operations.

Mr. KENT. May I comment on that?

Senator HUMPHREY. Yes.

Mr. KENT. It may be beyond the scope of this morning's hearings now, but in studying the bill, S. 3126, I believe the number is, we noted the suggestion for establishment of a national institute of chemistry, physics, and the other sciences. We felt that if that were done, the field of documentation and documentation research should have equal status. It was suggested that although perhaps sufficient agencies might already exist for conducting of research, still, such a national

institution should be set up on a parallel with the others, if others are set up. It was in that spirit that we suggested it.

Senator HUMPHREY. Well, in the field of aeronautics research, for example, we have set up the National Advisory Committee for Aeronautics, which is a type of institute in the field of aeronautics.

What we are trying to do is not have the Federal Government do all the research in aeronautics, because we have tremendous research going on at the industrial level. We have a national advisory committee or council that tries to coordinate these activities, which has a sort of quasi-public status. Isn't that about what we are talking about here?

Mr. PERRY. Yes.

Dr. SHERA. Yes.

Mr. KENT. Yes.

Senator HUMPHREY. It is something to bring together the men of your competence, to be quite specific about it, into more than just a private relationship, where you lay down a sense of direction, a program, a set of objectives to be achieved, and you measure it every 6 months or every year to see whether these objectives are being accomplished. I think that is what Senator Martin had in mind in terms of the approach to this, to utilize the resources which we have without the club. We use carrot instead of the stick. You catch more rabbits that way, they say.

Mr. KENT. We had planned, when planning this morning's presentation, to show a short film illustrating some of the work we had done. Since so much time has passed, we would be willing, if you wish, to withdraw the film.

Senator HUMPHREY. I know we have other witnesses here, and we don't want to deny them the chance to be heard. But this is such an important subject matter. Senator Lausche indicated he would like to see it. How long is it?

Mr. KENT. Thirteen and a half minutes.

Senator HUMPHREY. Do you think it would help us?

Mr. PERRY. Yes; because as I said, our contribution would be mostly in the realm of methods, techniques, and so on.

Senator HUMPHREY. Let's go. You have convinced me.

Mr. KENT. Before this film is shown, I would like to take just about 15 seconds to indicate that this is a film describing a project, a research project for the American Society for Metals being done in our center. It indicates some of the newer tools that are in pilot-scale testing at this time.

(At this point, a film was shown.)

Senator HUMPHREY. We want to thank you very, very much. I'm sure you realize that we have all been very much impressed with what you have done and said here today. Indeed, the film was very effective, very informative. It is amazing.

Dr. SHERA. We are certainly grateful for the opportunity to talk to you about these problems, and we will, of course, be glad to answer any questions you may have, either now or in the future.

Let me say one thing in view of some of my rather pessimistic remarks. When I think of the progress that has been made over the past 10 years, I believe that we are getting places. There is no question about that, but it is later than we think, and the whole question is can we outrun catastrophe?

I certainly hope so.

Thank you very much.

Senator HUMPHREY. We'll want to include in your testimony exhibit 12 and exhibit 13, in which are proposed immediate steps and recommended investigation by the Government agencies, as well as including for reference in our files this more technical exhibit of yours, No. 15, which is a development of the theory of documentation. I think we'll just make note in our record that we do have this particular document so that it can be referred to if others so desire.

We want to thank you. We have other witnesses and we undoubtedly will have to call upon you again either before the subcommittee, or the staff will call upon you.

Dr. SHERA. We'll be available whenever you want us.

(Exhibits 12 and 13 are as follows:)

EXHIBIT No. 12

PROPOSED IMMEDIATE STEPS

In order to exert as much pressure as possible toward the alleviation of the problem of assuring effective exploitation of the world's scientific and technical information and to improve our position in the documentation field with regard to the U. S. S. R., it is recommended that serious attention be directed to the establishment of a model scientific and technical information exploitation center, which could begin to serve immediately as a service organization to Government, industry, and the professions, and also serve as a pilot operation and model for other similar activities.

In the past, many fears have been voiced with regard to centralized scientific information efforts. These have included—

Competition with present-day commercial and professional information services;

Lack of a tested procedure for using searching, correlating, and translating equipment in an effective scientific information service in the size and scope that appears needed.

It is possible only by means of a model and pilot exploitation service to investigate optimum deployment of available resources so that useless competition is avoided, and so that procedures are tested by actual services rather than by conjecture and unscientific polemics.

Sufficient experience in the newer and mechanized exploitation services have already been achieved [1] to warrant recommendation of the establishment of model and pilot information services in the various scientific and technical disciplines. Attention would be directed to models and initiation of pilot exploitation services in a number of scientific and technical fields.

We have estimated that full operational status for a national center for the coordinated exploitation of the world's scientific and technical information could be achieved in a period of 10 years at a cost of $36 million. It was further estimated that by that time a self-supporting status could be achieved through a balancing off of costs and income from services provided.

During the first 2-year period, in order to provide adequate models and to perform the needed additional development work to permit the offering of the first operational coordinated services, we find it necessary to develop financial support from Government or other sources during the forthcoming 2-year period. The extent of our requirement involves:

(*a*) Equipment:	
Searching and correlation	$150,000
Automatic encoding and translation	150,000
(*b*) Pilot developments (similar to the program developed for the American Society for Metals)—in fields of science and technology	100,000
Total for 2 years	400,000

[1] See Tools for Machine Literature Searching: Semantic Code Dictionary; Searching Equipment; Applications, edited by J. W. Perry and Allen Kent, Interscience Publishers, Inc., 250 Fifth Avenue, New York, N. Y., 1958 (in press)—approximately 1,200 pages.

EXHIBIT No. 13

RECOMMENDED INVESTIGATIONS BY GOVERNMENT AGENCIES

It is recommended that the responsible agencies be requested to provide information for expert scrutiny with regard to their documentation programs and decisions which indicate what steps they have taken or plan to take in order to determine—

(*a*) The clientele to be served;
(*b*) The degree to which the clientele is actually being served;
(*c*) The degree to which the clientele could be served by more sophisticated services;
(*d*) The relationship between—
(i) The cost and value of services now being provided;
(ii) The cost and value of services that could be provided;
(*e*) The documentation methods or procedures they have investigated rigorously;
(*f*) The procedures by which they have investigated such methods and procedures.

(Exhibit No. 15 will be found in the files of the subcommittee.)

Senator HUMPHREY. Our next witness is Mr. D. C. Hilty, who is manager of the research information division of the Metals Research Laboratories, Electro Metallurgical Co., Union Carbide Corp., Niagara Falls, N. Y.

Mr. Hilty, we thank you for your willingness to share your observations and knowledge with us.

Mr. HILTY. Thank you, Senator.

Senator HUMPHREY. Do we have a copy of Mr. Hilty's statement?

Mr. HILTY. I believe there are enough copies of my statement for each of the Senators.

STATEMENT OF D. C. HILTY, MANAGER, RESEARCH INFORMATION DIVISION, METALS RESEARCH LABORATORIES, ELECTRO METALLURGICAL CO., UNION CARBIDE CORP., NIAGARA FALLS, N. Y.

Mr. HILTY. I will try to stick closely to the subject and be rather brief. Before I get into it, however—just by way of identifying myself a little better—I'm called the manager of research information. Research information is a unique term that has a specific connotation in our organization. It is one that we coined, really, to mean information, evaluated information, for management. A more modern description of it might mean operations research.

In that sense, we obviously have to depend a lot on published information. In my department, as one of the functions of this department, we do operate a technical information service, library, and so forth, for our own laboratory and technical groups. That is not the main function of the department; it is one of our tools, you might say.

For the past several years, many of us in the technical end of industry have been becoming increasingly concerned over the growing problem of quick availability and accessibility of published information. It is our feeling that the problem is of such magnitude and importance that its solution may well be vital to continued substantial growth of the national economy in the years ahead.

For this reason, I and some of my associates have made it our business, more or less, to try to carry industry's case to the people in the documentation field, in the hope that we might be able to stimulate

them to do something about it. For example, I am a member of the American Society for Metals documentation committee. I was chairman of the special ASM committee that established the project at Western Reserve, which has been described in the film you have just seen. My purpose here, I think, is primarily to describe what the needs of industry, as we see them, are in this field.

The information requirements of industry are many and varied, but they are, perhaps, most tangible in research, development, and technical control. The primary objective of industrial research is the discovery of new products and processes that will contribute to economic growth. Secondarily, there is also the objective of the improvement of existing products and processes, so that the organization can maintain a competitive advantage in our expanding economy. In addition, there is the overall broad objective of research to discover new knowledge that in the future may provide the basis for new product and process research. To a major degree, these objectives are attained through the coordination of information. Specifically, their attainment involves understanding of scientific principles, thorough knowledge of technology or the application of these principles, and close familiarity with industrial art—and art may be a long way from science in some industrial fields. In addition, a fairly rational estimate of economic potential is desirable for any new product or process or for modifications of existing products and processes in order to guide the research effort into the most productive channels.

Technical progress and economic expansion are being accompanied by a corresponding growth in the complexity and scientific content of research programs, with a resultant departure from traditional empirical experimentation. In days gone by, we used to take a couple of bottles off the shelf, mix them together, and have an invention. We cannot do this any more. Things have become too complicated. In modern research, the scope of any subject includes many disciplines. This situation is well illustrated by the recent announcement of the Bureau of Mines regarding the extraction of metals, such as copper and manganese, from low-grade ores by bacterial action. In the sciences of microbiology and biological chemistry, which seem about as remote from mining and metallurgy as one can get, it had been found that certain bacteria can "burn" or oxidize sulfur. Many ores contain small concentrations of copper or other metal sulfides which are difficult and costly to extract by conventional pyrometallurgical techniques. By permitting the bacteria to act on the ores, however, the sulfides were converted to sulfates which are soluble in water and easily leached out of the ores. This discovery opens up a whole new approach to similar metallurgical problems.

Research laboratories spend on the order of one-quarter of their time searching the literature, all too often with incomplete results. In terms of actual cost, literature research may be from 30 to 50 percent less expensive than experimental research, but incomplete literature searches can lead to unnecessary experimentation and duplication of effort, with consequent waste of time and valuable highly skilled manpower. Any research laboratory can cite numerous instances of spending thousands of dollars on research programs only to find later that the work had already been done elsewhere, or

that correlation of facts already published would have solved the problem much more quickly.

Senator HUMPHREY. We find this to have been the case in some of the governmental research programs, where actual projects were permitted or authorized and undertaken through one of our agencies of Government, on research projects in midstream, only to find out belatedly, by having examined some literature that was brought to the attention of the research people on the project, that it had already been done.

Mr. HILTY. That is right. It happens all the time. It is one of the things that already bites us, too. We have a limited number of research dollars to spend. We want to get the most out of them that we can, so, when we spend them on something that has already been done, this is just plain, unadulterated waste.

In this regard, it should be noted that time is one of the most precious commodities of research, since on the order of 7 years can be expected to be required for an idea to progress through research and development into successful production. In the interest of saving time, however, it frequently seems expedient to proceed with experimental research because of difficulties in locating the pertinent literature.

Development, as distinguished from research, has a principal objective of demonstrating the practicability, that is, economic feasibility, of a new product or process and introducing it into commercial use. Development is also concerned, to a much greater degree than research, with the improvement of existing products and processes and expansion of their applications. These objectives are essentially of an engineering nature, and development's information requirements are predominantly for engineering knowledge—technology and industrial art—of a scope at least as wide as research, but consolidated into a more usable form. Moreover, the need for reliable economic information on which to base estimates of market to provide bases for eventual construction of plant is urgent.

Extension of a company's interest into new markets, as well as the increasing technical trend in traditional markets, are continually compounding the complexity of development and adding to its cost. Moreover, due to the much higher costs of development as compared to research, time is even more of a factor than in research. Consequently, information of an engineering and economic nature, wide in scope, that will reduce pilot-plant work and market development to a minimum is highly desirable.

An illustration of the role of information in development problems can be found in the case of the metal, tantalum, that is presently in an advanced development stage. Tantalum is intimately associated with its sister element, columbium, in nature, and separation of the two is a difficult task. Research demonstrated, however, that a combination of ore-dressing techniques and chemical-engineering procedures borrowed from the field of organic chemistry followed by electrolysis could separate tantalum from columbium and permit extraction of the pure metal. Research also demonstrated that the properties of tantalum were especially suited for applications in the chemical industry, where corrosion resistance is important, and in the electronics industry in vacuum tubes and electrolytic capacitors. Consequently, development's problem includes engineering a process

for large-scale production of tantalum and engineering products suitable for both the chemical and electronics fields. Solution of this problem requires knowledge of ore dressing, chemical engineering, organic chemistry, and electrometallurgical technology to design the process and information on electrochemistry, electronics, physics, and fabrication methods, along with specific data on the chemical and electronic industries to design and market the product.

Technical control in industrial operation is the control of operations at the optimum conditions to provide maximum quality of product at minimum production cost. It requires digestion and dissemination of information to utilize more effectively what is known. The requirements are on a day-to-day basis, so that immediate availability of digested information is essential to the rapid and economical development of a product, as well as to maintaining production standards at competitive levels. Such digests can be made, and are, in fact, made to a limited degree, but their preparation is costly and demands maintenance of a rather substantial staff for the purpose if they are to be turned out in time and in sufficient quantity to be of greatest value.

The magnitude of the importance of information to research, development, and control can be judged from the history of one new material, titanium. On a national basis, the titanium project resulting in the production of mill products has cost $1.5 billion over the past 10 years. Of this amount, approximately $60 million has gone into research and $300 million into development. The large jump in costs from research to development is notable, since it illustrates in a typical way that development is much more costly than research and, thus, the economic significance of information in getting a new product into commercial use. No one can say how much improved means for retrieving, evaluating, and disseminating information might have expedited this program or have eliminated duplication of effort and otherwise reduced costs. Obviously, any saving would have been worthwhile. In this connection, however, it is of interest that, as the work on titanium progressed, the difficulty of keeping track of all the information pertinent to titanium—which was rapidly increasing—grew so excessive that a special information center on this one subject was set up in 1954 at Battelle Memorial Institute at a cost of $1 million per year. That center has proven invaluable to those concerned with titanium research, development, and production.

The total cost of research and development in the United States is currently at the rate of approximately 2 percent of the gross national product, and is increasing at a faster rate than the gross national product. This situation is a natural consequence of scientific and technical progress, which continually add to the complexity of research and development programs. It implies, however, that research and development may be in danger of growing excessively to the point where they require a disproportionately large share of income for support, or they may lose productivity, or both. In any case, the effect on progress could be most serious. This cost must be reduced if we are to compete in the world and avoid a technological ceiling. More effective use of scientific and technical literature will help combat this trend. Moreover, as Dr. Waterman, of the National Science Foundation, recently pointed out, the large costs of development and technical production control can be drastically reduced by employing operations-research techniques for greater efficiency.

Operations-research methods, however, will have to be based on complete data and, therefore, require better access to information. Furthermore, with the serious shortage of technical and scientific personnel that is presumed to occur during the next 10 ot 20 years, any saving in the effort to retrieve information will be invaluable.

Technical and economic growth are being paralleled by a corresponding increase in the pertinent literature. The ASM film touched on this increase, and I believe Dr. Shera did, too. The volume of technical literature is approximately doubling every 10 years. In round numbers, this rate of growth means, according to G. G. M. Carr-Harris, of the National Research Council of Canada, that some 60 million pages are being added to the technical literature every year. Consequently, it is readily apparent that accessibility and utilization of technical information to fill the needs I have outlined is a problem that has reached the acute stage and threatens to become hopeless in the near future unless improvements in existing methods of information retrieval, evaluation, and dissemination are initiated promptly.

Abstracting of the technical literature is done in a fairly competent manner by existing agencies, so far as individual documents are concerned, but the extent of coverage is poor, and there is excessive duplication in those areas that are covered adequately. In my own field of metallurgy, for example, spot checks in our laboratory have shown there is at least fivefold duplication of abstracting on some subjects and practically no abstracting at all on others of interest. Moreover, due to the broad scope now inherent in research activities, it is almost essential to subscribe to all abstracting services in order to be sure of obtaining the best possible coverage of all disciplines that may be of interest. This situation has led to considerable confusion, lost time, and waste of highly trained manpower. Presumably, the cost of abstracting could be materially reduced and its efficiency substantially improved by elimination of overlapping responsibilities. It is gratifying to note that a number of the abstracting agencies have recently gotten together to consider this problem and, possibly, develop a plan for improving the present situation. Incidentally, the same comments regarding duplication and incomplete coverage of abstracting apply equally well in respect to translations of foreign-language documents.

In our opinion, however, the real heart of the information-retrieval problem is indexing of the literature, either indexing of abstracts or indexing of original documents. From the user's point of view, an abstract is really a detailed index entry, so that a comprehensive index conveys almost as much information about a document as the usual abstract and is of considerably more utility in searching. Indexing is carried out inadequately by existing agencies and presents a problem of such magnitude that mechanical means are obviously indicated. Provided that adequate systems can be devised, the cost will probably be less than is now spent in duplication of abstracts. It is true that there are many factors that make this an exceedingly complex problem. Aside from the semantic and technical differences of different disciplines, there is a multitude of proposals for accomplishing information retrieval and a wide variety of individual opinions and needs. Resolution of these differences, through definition of common objectives, so that pilot tests of the more promising methods can be conducted promptly, is required. I mean pilot tests similar

to the ASM project extended into other fields and disciplines. If all of the various efforts that appear to be underway on information retrieval could be given centralized coordination, rapid progress could be expected. The effort should go forward as rapidly as possible.

Senator HUMPHREY. May I ask a question there? How do you think that a program for the coordination of this information should be undertaken? I'm very impressed with the excellence of your statement and the emphasis which you have placed upon indexing, which is, in my personal point of view, very worthy and very important, as well as the emphasis which you placed on pilot tests of the more promising methods that you have referred to here. Do you see a role for the Federal Government?

Mr. HILTY. Personally, I think I do. It may or may not be necessary—my views are very similar to yours on this matter, Senator. I believe that some centralized agency, whether it be Federal Government or not, has to stimulate action by getting the various different people that are involved together, orienting them, and getting them started. If this is done and we get the pathway established, then I don't believe that actual Federal control would be necessary. I don't know. I'm not in a position to make a specific recommendation, because what I am pleading for is that something be done. We, in industry, have got to have it. We don't propose to tell documentation people their business.

Senator HUMPHREY. You mean to say you feel you have to have it, not only from a scientific and technological point of view, but from an economic point of view?

Mr. HILTY. Yes, sir.

Senator HUMPHREY. This point has often been overlooked or underemphasized from the point of our own industrial progress and efficiency and the ability of our country to compete in these highly competitive markets.

Mr. HILTY. This is precisely it.

Senator HUMPHREY. Your plea is that the problem of documentation and indexing and correlation of research data and of development data and so on is very valuable from an economic point of view?

Mr. HILTY. It is. I can't emphasize that strongly enough.

Senator HUMPHREY. I'm frank to tell you this is something I hadn't really thought too much about, but I surely sense, immediately, the importance of what you are saying.

Mr. HILTY. Well, to a large degree the national economy—the growth of the economy—depends a good deal on producing new things that more people can use, and so goes back to the heart of research and development. However, in order to know what new things to produce and whether the way that we plan to produce them is going to justify the cost, economic information is needed. Otherwise, a lot of money might be spent on projects that are not worthwhile from the consuming viewpoint. This means that an industry can ultimately get to a point of insolvency, and such a condition obviously will affect the growth of the national economy.

Senator HUMPHREY. Senator Martin, do you have some questions?

Senator MARTIN. Is it your observation that this program we are considering here would be helpful in the conservation of our strategic and critical minerals and metals?

Mr. HILTY. Unquestionably, yes, sir.

Senator MARTIN. I think the Government has a very real interest in that field, especially.

Mr. HILTY. Yes, it most certainly does.

Senator MARTIN. Not only for defense, but for our economy, generally.

Mr. HILTY. That is right.

You know, we in industry are aware of this fact, too. We always consider the problem of conservation, because, well, we can't afford to produce a material—I'm speaking purely in terms of the peacetime domestic market and not on the basis of a military economy—we can't afford to produce a material for which we don't have a reliable source of raw materials.

Senator MARTIN. And there is a limited source of supply especially in the strategic and critical metals and minerals.

Mr. HILTY. Yes, there is.

Senator MARTIN. I think this will apply a little extra in the field in which you are operating. Do you?

Mr. HILTY. It does, and good, sound knowledge of the limitations on this supply is of utmost importance.

Senator MARTIN. Your testimony here is of special importance because of your familiarity with the field in which we need the greatest help, that of strategic and critical metals and minerals.

Mr. HILTY. We are certainly in agreement, Senator.

I am certainly no expert in the documentation field. In fact, I am a metallurgist. More than that, I am a physical chemist, and I spent most of my active research life working in the field of the physical chemistry of steelmaking. I do, however, recognize the information needs of scientists, technologists, and industry. I probably look at the documentation problem from an executive point of view tempered by engineering experience in my own technical field. Consequently, I become somewhat irritated and distressed when I attend meetings of documentation specialists who bear the ultimate responsibility for implementing the work on this problem and listen to them shy away from actually starting active efforts to test and evaluate various proposals that have been made on the ground that more research and more conferences on information theory are needed and more knowledge of how information is used is required. It may be quite true that information theory is not well-established and that better systems can be evolved when more information is gained. There is, however, no end to this argument. I would like to point out that when the first blast furnace was constructed, chemical principles had not even been discovered. Understanding of the theory of the blast furnace is still far from complete. The blast furnace today is costly to build and is still operated very much according to art. Nevertheless, it produces the most economical form of iron available and a whole civilization has grown up around it.

A revolution similar to that caused by the blast furnace is needed in the technical information field, and the longer it is delayed the greater is the danger of eventually jeopardizing our economy and security. Initially, the expense may seem large, but the returns will be worthwhile. It is a common problem that requires prompt and effective stimulation and coordinated direction for its solution.

Senator HUMPHREY. Mr. Hilty, I personally want to express my thanks to you for your willingness to share with this subcommittee

your expertise and knowledge in this subject. I know my colleagues will have questions to ask of you, but, first, I want to throw this one question out to you.

Do you think industry would actively and willingly participate in a program of greater coordination of this scientific data if there were some leadership based upon a central point of direction from, let's say, the national level? I'm not talking about a federally controlled project, but let's say a project at the National Government level that would lend itself to a greater coordination of effort, establishing goals to be accomplished, and laying out, as you said so well, a path that we might follow?

Mr. HILTY. Sir, I'm sure that industry would. I can't speak for all industry, of course, and, really, all I have to go on is history; but wherever anything promising has appeared, industry's attitude has been, well, let's get on with the job and let's support it.

Take our own case in Union Carbide Corp. Obviously, this job is too big for us to do anything about it directly by ourselves. It is way beyond us. It is a national problem.

Senator HUMPHREY. Yet you are one of the big companies.

Mr. HILTY. We are one of the big companies. Historically, we have been interested in the problem, however, and we are helping support efforts in the field. For example, as I said, I was chairman of the committee of the American Society for Metals that got the project started at Western Reserve. This means that we cooperated with the ASM by giving the time of technical personnel. We are cooperating in a similar, though so far more limited, way with the American Chemical Society. More than that, we are contributing by a grant-in-aid to support of the center for documentation research at Western Reserve. Other industries are doing similar things. But they want to be sure that they are going to get something for this support. I don't think that there is any question of getting industrial cooperation, so long as industry knows rather specifically what might be expected.

Senator HUMPHREY. Senator Lausche?

Senator LAUSCHE. You are of the belief that if a program of the type which has been discussed here this morning is instituted, it would release many scientists from work which they are now doing, and make them available in other fields of scientific research? I have in mind your statement that it takes 7 years between the time of research and the ultimate production.

Mr. HILTY. That estimate is kind of an average expectation.

Senator LAUSCHE. Much time is lost by doing duplicated work where one research group is doing that another is also doing. It is a fair deduction to say that we would increase the available working hours of scientists; is that correct?

Mr. HILTY. Yes, sir; we would have the net effect of increasing the available working hours of scientists.

Senator LAUSCHE. Might I ask you this question?

Mr. HILTY. Yes, surely.

Senator LAUSCHE. It may not be pertinent, but what is your belief or opinion concerning the adequacy of the number of scientists that we now have? And technical men?

Mr. HILTY. You mean the adequacy——

Senator LAUSCHE. I mean in number.

Mr. HILTY. You mean do we have enough scientists?
Senator LAUSCHE. Yes.
Mr. HILTY. No, sir.
Senator LAUSCHE. We don't?
Mr. HILTY. No, sir, we don't.
Senator LAUSCHE. That is all I have.
Senator HUMPHREY. Senator Martin?

Senator MARTIN. By relieving some of the scientists from some of the problems they now have and conserving their time and their energy for futher developments in the metallurgy field, we could conceivably go much further in developing our substandard ores and making available a much greater supply at less cost than now of those substandard ores and develop them into higher quality and greater quantity. I have in mind the field of manganese, for instance. We have such a vast amount of substandard ore, and cost is the very thing that is keeping us away from our own supply.

Mr. HILTY. That is right.

Senator MARTIN. That is the very item that makes it impossible for us to talk in terms of massive development of our own supply, and we are terrible, terribly short in our own self-sufficiency in that field. There is where it would pay off immediate dividends in reducing the costs to our ndustries who are tying so hard to conserve and utilize and develop the materials which we have to work?

Mr. HILTY. I would expect that this would be one of the results. Of course, in this kind of business, you can't guarantee anything, because nature works in strange ways, sometimes. But certainly by being able to put more effort or more efficiency into the existing effort, we can expect a solution faster, and—well—the results are a matter of statistics.

Senator MARTIN. It would be most unfair of us to ask you to make an estimate of specific progress you can predict from this system. I don't think it is possible for you to do that.

Mr. HILTY. That is right.

Senator MARTIN. But it would be a step in the right direction?

Mr. HILTY. Yes; there is no doubt in my mind.

Senator HUMPHREY. Mr. Hilty, we are deeply grateful to you and the company which you so ably represented this morning. We thank you. You will undoubtedly hear from us again.

Mr. HILTY. I'm available to the committee at any time.

Thank you very much.

Senator HUMPHREY. I think we should tell our gusets and our witnesses that Senators are just demons for work today, and Senator Martin and I are going to come back at 2:30. I understand Senator Lausche will not be able to be here at that time because of a previous commitment. I hope you will, Senator Martin.

Senator MARTIN. I hope I can.

Senator HUMPHREY. Right now, I would like to hear from Capt. I. R. Maxwell.

STATEMENT OF I. R. MAXWELL, DIRECTOR, PERGAMON INSTITUTE, NEW YORK CITY

Mr. MAXWELL. I have seen the Institute of Scientific Information of the U. S. S. R. in operation in Moscow some 2 years ago. In

principle neither this country nor any other democratic country needs or requires such a central information center.

Senator HUMPHREY. Mr. Maxwell, before we go any further, I would like to have you identify yourself a little more for the record, because people will read this record, and we want them to know of your background.

Mr. MAXWELL. I am the director of the Pergamon Institute, a nonprofit institution set up for the dissemination of scientific information and improvement thereon. At the moment, the institute is particularly active in making available the result of research and development from the U. S. S. R., China, and other Iron Curtain countries in the fields of biology, medicine, physics, metallurgy, et cetera.

Senator HUMPHREY. Your institute is privately sponsored?

Mr. MAXWELL. It is privately sponsored, principally by the personal support of many scientists.

Senator HUMPHREY. I see.

Mr. MAXWELL. My reasons why the assembly and dissemination of scientific information under Federal control would be of no service or use to this country, and why you should not emulate the Russians in such a center are: (1) the Russians, with their centralized form of government, control every segment of their society by ukase. Therefore, it is very easy for them by ukase to establish such an agency.

(2) The reason they established it is because they were, for a great many years, in need of scientific information from the West. During the past 20 years or so, the basic advances in U. S. S. R. science and technology were unquestionably due to what they gleaned from their colleagues in America, Germany, France, and so forth. This is not to minimize their own contribution, but it is only recently that they have begun to reap the benefit on a large scale of their educational system and to produce valuable scientific results from their own brainpower and manpower. They are now using the information from us to supplement their own work. Because of their form of government, administrative organization of science, and restriction on travel, the Russians need this kind of centralized information agency to feed to their scientists the information from all over the world, whereas American scientists who can travel freely and have many personal contacts throughout the world do not require such an institution.

(3) Some of the speakers that I have listened to this morning do not seem to give sufficient credit to the tremendous amount of information being exchanged by scientists, personally and privately, both by letter and at the many scientific meetings and symposia they attend at home and abroad. This is still one of the most efficient ways of disseminating technical information quickly, without having to wait for some middle man, documentationist, or printer to get it into print and eventually disseminate it.

(4) An additional point against such an institute coming into existence is the tremendous amount of opposition there would be from the recognized learned societies, because they would judge that the Government was duplicating and usurping their function in work which they are doing very well. These societies and industrial associations are in need of financial help from the Federal Government, to make more and better use in the dissemination of the available

scientific information, not just from abroad, but also from this country. The raison d'etre of these learned societies and industrial associations and the only reason people sponsor and support them, is primarily for the purpose of obtaining technical and scientific information. These societies are in daily touch with industry, engineers, and the individuals who are personally engaged in research and development work.

For these reasons, I suggest that the learned societies and trade associations are the best and most efficient medium, as well as the cheapest, soundest, and healthiest body for disseminating scientific and technical information. By superimposing any new Institute of Scientific Information you will create confusion, delay the information from getting into the hands of the people who can use it, and render a very poor service to this country and the free world.

I recommend that the Federal Government should concentrate its efforts on educating the scientists and their administrators to make better use of existing information resources, and raise the stature and standing of information officers and librarians.

I further recommend—and this is a most serious point and should be given most urgent attention and if possible immediate action—that the Government should set up a department to encourage private industrial firms to be freer in their release of scientific and technical information than they have hitherto. The Government should also encourage private firms to make available their industrial know-how on a nationwide basis. This is an area in which learned societies and trade associations have been able to do very little. The Federal Government is the only agency that is eminently suited to undertake this task. Such a program, if successfully undertaken, would greatly increase our productivity and efficiency.

It must be recognized that in the problem of making information available, the totalitarian system of government in the U. S. S. R. has a tremendous advantage over the free enterprise system. In the U. S. S. R., the time required by industry to take an idea off the drawing board and put it into hardware, whether this be missiles or trucks, is 3 years in comparison to roughly 7 years under our system of free enterprise. All of you ladies and gentlemen have been surprised with the ease with which the Russians are putting into production their heavy bombers, missiles, and new housing units, for instance. The reason for this is not any Marxist philosophy or theory, nor the size of the Communist Party in the U. S. S. R., but that under their system the government owns everything, and industrial know-how and technical information is disseminated throughout the country the very day it becomes of value to one particular factory; whereas under free enterprise each individual firm, small or large, guards this information jealously. This results in an enormous amount of duplication, wasted effort, and loss of time which cannot be calculated in cost to this country and the free world.

With regard to the translation of current Russian literature, this is being carried out with the assistance of the Federal Government at a cost of some millions of dollars, and is a very slow and wasteful method of making information available. Our scientists and engineers do not have the time to read the original American literature, and now they are receiving additional large volumes and quantities of translated material. Not only is it a great compliment to the Russians that

we are publishing this material, but I do not believe that any good use is made of it. I have not heard that, as a result of reading a translated Russian book or article, any research worker in a particular field has been able to make use of the information therein to save some money or time on the research in which he is currently engaged.

Senator LAUSCHE. Would you repeat that statement, please?

Mr. MAXWELL. To make available translations of some of the Russian journals and monographs is an extremely wasteful effort. I do not believe that any American scientist or engineer engaged in research or development can be found who has read one of these articles and can prove that, as a result, he has been able to save money or time. This program ought to be cut off, say sometime around 1960—this is an arbitrary date. Instead scientists should be encouraged to read Russian in the same way that they read French and German. If they are engaged in a particular area of research, these scientists should read the original Russian literature. Thus they will be able to select for themselves what they want out of the Russian literature, or inform their colleagues of an article which has come out of Russia today that may be of use in their research work.

Senator HUMPHREY. If they don't learn anything from the Russian literature by reading a translation, why read it in the original Russian?

Mr. MAXWELL. By the time the translated article reached them, it may be as much as a year old. The translators can never quite convey the sense to a man who is versed in, say, solid-state physics can obtain from reading a Russian article himself.

Senator HUMPHREY. I surely see the advantage of language proficiency, and I'm all for encouraging it. But it has been said that there are no great secrets ultimately in science. I don't know whether that is a cliche or not, but I suppose that somewhere along life's span, scientific information has a way of catching up with people, or people catching up with it. But there have been some basic scientific studies made in the Soviet which might be of some interest. For example, I read in the press the other day where some Soviet scientists were contesting certain basic assumptions of established science. That, of course, broke loose in the American press as I suppose it did in the press of other countries. But in order to really get the gist of it, knowing that the press tries to condense the Encyclopedia Brittanica in two paragraphs, which is a neat little task by itself, I think it might not be a bad idea if people who were really interested in this matter would read it. I realize that people don't like to read now days, but I'm trying to encourage it

Mr. MAXWELL. It is only recently that our people became aware that it is ridiculous to cut themselves off from this source of research and development in the U. S. S. R., because initially the Russians would not make this material available; now that it is available, we have come to realize that some of it is worthwhile. Obviously the programs that have been started by the National Science Foundation and other agencies are good and sound, as long as they are just a stopgap. Since these programs have been started, a lot of money is being spent on them, and knowing what Government programs are like, once they get started, they are difficult to stop. This is one program that should be stopped.

Senator HUMPHREY. The U. S. S. R. spends vast sums of money and has literally thousands of translators working on documents from

other countries. I appreciate what you said earlier, that the Soviets tried to catch up, so to speak, and fill in those gaps. I have talked to many scientists, in fact, I went home to my own great university, the University of Minnesota, awhile ago, and met with Dr. John Williams, who has just been appointed Research Director of the Atomic Energy Commission. He and I met with a group of other scientists, and we discussed this bill before us in a free for all. I was essentially trying to get information from them.

Now, they said to me, and other scientists that I have talked to have said that Soviet scientists are now at a stage of development where they are creative, where they have filled in the gap, where they are competing at western levels of competence, and at times are making breakthroughs that we haven't; of course, we make breakthroughs where they haven't—I mean, there is real competition in it. If that is the case, why is it that the Soviet Union continues to translate madly with great determination and almost extravagant outlays of money every conceivable journal from the western culture?

Mr. MAXWELL. First, I do not agree, Senator, that the Russians are on a par with us, by any means; certainly in physics, but in chemistry and other areas, they are behind us much as 20 years.

Senator HUMPHREY. They are supposedly behind us at least that far in basic research.

Mr. MAXWELL. The idea of Russian advances in science is something like the curate's egg; good in parts. Of course, one cannot cut off 120 million people and not worry with what they are doing. They obviously have a lot of competent people over there.

What you are saying basically is that because they are doing it, it must be right. I disagree with you. I have met with quite a few Russian scientists who do not think much of their Russian Scientific Information Institute. When the Academy of Science of the U. S. S. R. takes closer look at its budget and sees what this Institute is costing, the Russians will be anxious to abolish it. They will not be in the position the United States is with its flourishing healthy and independent learned societies because the Russian scientific societies are very weak and ineffectual, precisely because of the existence of the Institute of Scientific Information.

Senator HUMPHREY. I don't want to belabor the point, since this is just for emphasis. Here is one of the reasons I was concerned about what you had to say. This is from the Federal Bar Journal, the July-September 1957 issue placed in the record of these hearings by Dr. Shera. I'm reading from page 236 of the article entitled, "The Dissemination of Technical, Scientific, and Engineering Information as a Factor in 'Competitive Co-Existence' by Jennie and Herschel Clesner:

> In 1950, a Soviet scientist, A. G. Lunts, published a paper in a journal of the U. S. S. R. Academy of Science dealing with the application of Boolean algebra, or symbolic logic, to the design of relay contact circuits in computers used in modern machines and weapons. The journal was readily available in this country, but from 1950 to 1955, scientists of the various American computer manufacturers attempted to do the same work over again because they didn't know the paper existed. They wasted 5 fruitless years and large amounts of research money before someone discovered the publication.
>
> This story is not an isolated incident. The situation probably will be repeated many times in the days to come for a great flood of Soviet scientific publications are coming into this country due to the improved availability and the increased output of Soviet scientific research.

Then, in a footnote, he says:

National Science Foundation in its last report to the Congress stated that "several cases have come to light in which, due to the language barrier, American scientific and engineering progress has been retarded by our lack of knowledge of research and development already completed by the Soviet scientists * * * the development and perfected by the Russians of a turbodrill for speeding the drilling of oil wells. This development was published by the Russians in their own literature 6 or 7 years ago, but was not known to our engineers until recently because of the problem of translation and the lack of operating facilities for abstracting and distributing such information. There have been other cases where valuable time was lost because we were duplicating work Soviet scientists had already completed."

Senator HUMPHREY. I have heard of similar instances again and again. It just seems to me that while you can overdo this business of wanting to translate every living thing the Russians publish, every scratch of paper that comes out, I don't think that we ought to assume that translations do not have a very important role to play. Not only of Soviet materials—I think this country has gone berserk on these things. We consider, apparently, that the only competition we have is Soviet competition. My friends tell me that there are fantastic scientific developments taking place in other parts of the world, to wit, China, Japan, the Balkan States, and we go around sort of feeling these Russians are supermen and the rest are pygmies. I don't know what has come over us.

What I am trying to get at essentially is why one would want to say these translations should be concluded by 1960.

Mr. MAXWELL. Precisely because there has been a great deal of propaganda about Russian scientific superiority, it has become possible to get substantial funds for translating Russian material. This was not the case 2 years ago. This present state of mind was helped by 1 or 2 points, such as the one Dr. Waterman quoted in his report to President Eisenhower, where the electrical industry did some $200,000 worth of research and development work on switch gears, the basic details of which were available in the Russian literature. There was nothing wrong in duplicating this or any other piece of research, otherwise where will the United States scientists get their capability from in this area if they are going to just pick up what the Russians have done? Maybe it would have saved us a little time, but it was not wasteful.

Senator HUMPHREY. I wouldn't say it is absolute waste. It is perfectly true that one in his own activities might even get a perfection of the elemental research accomplished, but, and I say the but is very important, but if you do have a paper to work from or a basic dissertation on the project that has been laid out before you, and even then, that surely gives you some advantage, and it gives you a starting point that would be helpful.

Now, I think again it is a matter of emphasis. I'll agree with you in this sense, that we may be taken in by the emotion of this thing of Soviet achievements. I think we have. This is not the first time we have been taken in. We were taken in before on the idea that the Russians were a bunch of peasants. That notion satisfied some people's notions of their life. People said, "It's evil, and we'll not look at it any more." People have these blinders, you know that they pull down when they don't want to see something. They fail to recognize that the devil has a lot of things to say, too.

There must be a happy medium between the extremes that the Soviets can do nothing in basic science or that we ought to see everything they do.

Mr. MAXWELL. The happy medium is not translation. The happy medium is the Shera-Perry machine that will give you complete bibliographies. How is it that this research coordinator missed this item of Russian literature on computers? They missed it basically because we do not have an efficient bibliographic systems.

Senator HUMPHREY. Now, wait, there you are coming around. This is like research. It helps if you keep working on it. What you are saying is had there been adequate indexing, the kind of bibliographical material, translation or no, had that been in a machine so you could have retrieved it and selected it and correlated whole batches of it, you would have found this material, and then competent research people would have at least been able to get it translated at the time they needed it if they couldn't read it themselves.

Mr. MAXWELL. That is right. One of the things a team must do before they start a scientific program on any topic is a complete literature search. I am surprised that the bibliographic researchers missed this information because the services in existence are not as bad as they are made out to be; but they have not been getting the Russian information before. Now that the Russians are releasing it, the scientists, for instance at Harvard, who are starting a research program on computers would have noticed it, even with the existing services. However, the existing services are very slow and cumbersome. There is no doubt at all that the effort of transferring this work of storage and retrieval onto machines is very necessary and very badly needed, if our whole system of disseminating information and making use of it is not to breakdown.

Senator HUMPHREY. I think your emphasis is well made. Don't misunderstand me. I wasn't trying to argue with you. We want different points of view, and it is possible that some people are taken in. I have been taken in many times. I speak for no one else. But I think it is important that we get from men like yourself who are so deeply involved in this, a personal evaluation, not or whether or not we do this or that, but what if anything we should do. I started on the assumption that everything we have is not bad at all. I'm sure what we have is essentially good. It is a question, is it not, of bringing this vast array of material we have, and knowledge and science, on a focal point?

Mr. MAXWELL. This is where I disagree with you. There is no need for a focal point.

Senator HUMPHREY. I'm not talking about a focal point of control. If you have a research project, there is no use in having material in Timbuktu and some in Gander if you're not going to be able to get it together and use it.

Mr. MAXWELL. That is so. It should be left to the existing organizations. The Government should educate the people to the need of making more and better use of the technical and scientific literature. A lot of people today do not bother to go into libraries. One can go into a research establishment and ask the man working on a research project: How much time do you spend, how much time have you spent, since leaving the university, in literature searches? You will be staggered to find that they don't spend much time at all, seldom more

than an hour a week. They are so busy, their companies keep them busy, but they are not making use of existing information. So, to educate people in making more use of existing information is of great importance.

Senator HUMPHREY. What about the other part of it? People say to Members of the Senate, how much time do you have to spend on legislation? The answer is well, that depends on the number of constituents, you see. It depends on the mail flow. It depends on a great many things. You can either change the whole world, and thereby have more time, or you can organize your machines and bring in additional people so that you take care of the pressures as they develop. I'm speaking in terms of science. You are saying that these men are kept busy by their companies. I'm betting that it will be a long day before these men are kept less busy by their companies. Isn't it a problem of seeing to it that in the hour they do have they get five times as much information as they got before?

Mr. MAXWELL. They cannot use it. My basic philosophy is—and I am quite certain it is the right one—that one should leave the matter of making use of information to the initiative of the individual. The Government should use its best endeavor to make management aware that better use should be made of the information. The worker correlating the information should make it available to the individuals through the learned societies and industrial associations to whom all scientists and engineers turn for kinds of information, such as about conferences. He has to read their magazines to see what products have been developed. Your responsibility should be to educate the individual, and to provide the additional money needed by the societies to enable them to carry out their functions efficiently, and where necessary, to put out translations from Russian and other languages. The Government should do all it can to see that American industry stops hiding and withholding masses of information which is no longer of use to them.

Lastly, the Government should spend a great deal of money and effort in the research and development of the storage and retrieval of information by mechanical means. This is a long, slow, and cumbersome process which will take many years; it cannot get done tomorrow. In the meantime, we can and will live with the existing systems. I am merely saying please do not saddle us with a central information organization, because that really would be a calamity of the worst kind for this country.

Senator HUMPHREY. I don't think there is a desire to do that, but you must say in your description of things to be done, you should do this and do that. I say who? This isn't going to be done by some act of nature. Possibly there are some who think that it will. But if you have to have money and if you want to encourage people and educate people and all the emphasis that you properly put on this, and then say, "We don't want the Federal Government to have a big agency for it"—I can go for that, too—but what kind of an organization is it that you want to do all this?

Mr. MAXWELL. You said earlier that there are a great many existing laws and regulations available to Federal agencies. My proposal is that you give these to the National Science Foundation as far as educating learned societies is concerned, and to the Department of Commerce as far as educating industry is concerned.

Senator HUMPHREY. The Department of Commerce has got it.

Mr. MAXWELL. But has not been doing very much with it, for the simple reason that there was no public outcry for it. There was a need for it. The technicians always wanted it. I am sure the Department of Commerce and the National Science Foundation would like to do more. You gentlemen sitting here have the whole world on your shoulders. I am amazed that you should give time to this very small technical problem. The United States Government has two very competent agencies. One is the Department of Commerce, in touch with industry on a day-to-day basis, who have the beginning of a program; and the other is the National Science Foundation.

Senator HUMPHREY. You think that a type of coordinating committee along the lines that I used as an example here, the National Advisory Committee for Aeronautics, you think something like that would be helpful, where you bring in private and quasi-public organizations?

Mr. MAXWELL. No, sir, I do not. I know the people at the Department of Commerce and at the National Science Foundation. They cooperate very well. If they get the necessary moral and financial support, I know they will have the cooperation of the scientific community as well as industry, and you will achieve with a minimum amount of money, time, and trouble, precisely what you are spending your time on now, the question of how to make better and more efficient use of scientific information.

Senator HUMPHREY. Senator Lausche?

Senator LAUSCHE. I did understand you to say, Mr. Maxwell, that a coordinating and stimulating agency of the Federal Government, without getting into the rendition of direct service, would be a worthwhile undertaking, did I not?

Mr. MAXWELL. No, sir; it would not be a worthwhile undertaking. The United States President already has a Scientific Advisory Committee. You have many existing agencies. By adding another one, all you are going to do is just confuse the issue. I cannot see any advantage whatsoever in creating another superagency. The public has now been made aware that we have billions of dollars stored away in information that has not been made use of, whether American, Russian, English, German, and so forth.

Senator LAUSCHE. Why shouldn't there be some Federal agency that would do this very thing you are now speaking of?

Mr. MAXWELL. Practice has shown that all new agencies do is slow down the process. They have to learn what it is all about. There is a very good machine for disseminating in the United States in operation which is the envy of my country, Britain, and everybody else. But unless you are careful, you will end up in doing the whole thing for the world.

Senator LAUSCHE. I concur with you in your fear that we may be drifting in that direction. My inquiry here is directed at the point that it might be advisable to set up a separate department which shall act only as a stimulating and coordinating agency, operating upon the private groups that are now in existence, making certain that to the best advantage we are utilizing our facilities. I'm glad to have your views, and I don't believe that we are improving ourselves by engaging in an argument. You have told your views. I listened to them. I know what they are.

I'll have to leave, Mr. Chairman.

I appreciate your testimony very much, Mr. Maxwell.

Mr. MAXWELL. Thank you, sir.

Senator HUMPHREY. I surely do appreciate it, and I appreciate more than anything, Mr. Maxwell, your candor.

Mr. MAXWELL. Thank you.

Senator HUMPHREY. We are recessed until 2:30 p. m.

(Whereupon, at 1:20 p. m., a recess was taken until 2:30 p. m.)

AFTERNOON SESSION

Senator HUMPHREY. Mr. Mack, please come forward. Thank you for arranging your schedule so you could be with us.

Mr. MACK. Not at all.

Senator HUMPHREY. Mr. Mack, you are the librarian from Lehigh University at Bethlehem, Pa.; is that correct?

Mr. MACK. That is correct.

Senator HUMPHREY. Please proceed.

STATEMENT OF JAMES D. MACK, LIBRARIAN, LEHIGH UNIVERSITY, BETHLEHEM, PA.

Mr. MACK. I have been librarian of Lehigh University for 8 years. I have been actively engaged with the work of the Center for Documentation and Communication Research at Western Reserve University for the past 3 years, and I am on the executive committee of the Council on Documentation Research, which I believe was discussed this morning.

I take it that my function here is to testify as to the probable effect of the Science and Technology Act of 1958 upon the work of American academic libraries. Let me say at once that my point of view is that of a librarian acting in the capacity of a middleman among working scientists. This places my views in appropriate perspective for the committee, and may prevent excessive narrowness in what I have to say. I should add for the sake of the record that I have read a copy of S. 3126.

The academic library's position in the context of the present bill is chiefly that of a consumer of scientific literature, and, insofar as the library supports research, it bears roughly the same relationship to the proposed Bureau of Technical Services (title I, p. 4) as "American business and industry."

I might add at this point briefly that according to the National Science Foundation in their publication NSF–57–24, the Atomic Energy Commission and the National Science Foundation together committed nearly $450 million to educational institutions, both proper and research, for research and development during the period 1956 to 1958, inclusive.

In more specific terms, there appear to be three activities envisioned for the Bureau of Technical Services which will definitely find a market among academic libraries. They are: Abstracting and indexing; machine literature searching; and foreign language translation. I should like to discuss these activities in that order.

First, abstracting and indexing. Up to the present time, it has been one of the principal functions of any library to subscribe to, to

make available, and to store for future use whatever periodicals seem appropriate to the teaching and research programs of the institution as a whole. In the usual case, the decision to subscribe to a given periodical rests upon faculty demand; but the quantity of such literature is now such that it is impossible for working physicists, chemists, and biologists to read and absorb much beyond a small fraction of it. They must have available a very rapid means of surveying the current literature regularly, and of following up references to the literature of the recent past. This means that the academic library should be able to provide indexes and abstracts to this literature.

The situation is exactly analogous to that existing in the law, and as a matter of fact also in the day-by-day proceedings of the executive and legislative branches of the Federal Government. But the abstracting and indexing of the contents of periodicals is far beyond the financial capacity of any one library. Such services must be purchased.

I take it that it is not the intention of the present bill to set up business in competition with existing enterprises. But I feel bound to suggest that the Bureau of Technical Services or, Senator, such an institute as Dean Shera has suggested this morning might well explore ways to assist the magnificent work of Chemical Abstracts, for example, so as to make it more promptly available. I might point out that the annual index to Chemical Abstracts for 1956 has not yet appeared; and that the decennial index for the period 1946 to 1956 will not be completely delivered until late 1960 at the earliest.

Senator HUMPHREY. You are pointing out the delay here that could have an injurious effect upon scientific progress, is that right?

Mr. MACK. Yes, sir. Chemists at the university have already come to me and talked to me about this problem. They are already feeling the 14-month delay on the 1956 index, for example.

Second, machine literature searching. Here I am talking about ultra-high-speed computerlike devices which, within defined limits, will be able quickly to provide highly specific references as we saw this morning on the film from within vast bodies of literature.

Again I might say that such devices might have applications for the legal field. This is relatively new ground in librarianship, on which few academic librarians have expressed themselves, largely, I think, because the devices themselves are still in the experimental stages. I am, however, completely convinced that when these devices become practicable I must, as a regular service, make the fullest possible use of their potential for the benefit of my colleagues at Lehigh University. Administratively, there would appear to be two alternative ways by which an academic library can do this. Either the library must operate its own equipment, which will probably be beyond the financial means of the vast majority of these libraries; or else it must subscribe to a service which will furnish literature searches as required, and at cost.

In the first case, no responsible librarian will purchase or lease a system and its equipment unless he knows that that system will be flexible enough to handle searches in a wide variety of subject fields. I might add that the present competition among computer manufacturers is not likely to resolve this problem.

The situation is highly fluid. In the second case, subscription to a literature search service emanating from a central agency must carry

a guarantee of the fastest possible service if it is to be effective. Many people have misgivings about the efficiency to be expected from a large Government performance component; however that may be, the hardware capable of delivering information at high speed is clearly possible.

In view of the uncertainties in the situation, the only responsible course for an academic librarian to take right now is to keep himself informed, and to encourage research in the field. Centralization under the Federal Government offers a means, and perhaps the only feasible means, by which this type of service can be brought within the reach of academic libraries.

Senator HUMPHREY. Are you suggesting there that the abstracting and the indexing and the translating be done then by a central Federal service?

Mr. MACK. No. I would much prefer to see the work of chemical abstracts continue to be done by Chemical Abstracts. I do not think that can be improved on except in the way I have suggested.

I rather incline to the position, Senator, that if, for example, the Library of Congress were to offer a service of machine literature searches, we would purchase their services. I am not prepared to suggest that a central agency of the Government be set up to perform this service.

Senator HUMPHREY. Do you think it would be possible to perform this service through some program of grants-in-aid to step up the existing facilities?

Mr. MACK. I should certainly think so; yes.

Senator MARTIN. Would that be your suggestion? Would that be favored?

Mr. MACK. If, let us say, an existing institution, private or public, were prepared, as I believe for example the Patent Office is now or the Center for Documentation Research is now I believe on an experimental basis only, I would certainly prefer to buy these services from them one place at a time for each subject. I do not really see why another agency should be set up. I would prefer to use existing agencies.

Senator MARTIN. Is there a real limitation here on the approach we make in this committee in the field of abstracting and indexing and this machine literature searching because of private enterprise being engaged in that work at present?

Mr. MACK. Actually at the moment, Senator Martin, I believe there is no service in machine literature searching available to me as a librarian at any price right now. No, I do not think there is a real limitation particularly.

Senator MARTIN. About the abstracting and indexing——

Mr. MACK. Will you rephrase your question again?

Senator MARTIN. Is there a limitation on the work of this committee, the plan we are discussing here now, due to the fact that there are private organiztions engaged in this field of operation?

Mr. MACK. If these private operations can be in some way coordinated, no. I do not think that problem as such constitutes a limitation on the work of this committee.

I think it is something to be solved. I do not think it is a limitation.

Senator MARTIN. I do not know how fully developed the present service is in this field, and I just wondered if there is a limitation placed on us because of private development of the abstracting and indexing services and also machine literature searching.

Mr. MACK. I do not see why, Senator.

Senator MARTIN. I ask such a question because on page 2 of your statement there you made the point, "I take it that it is not the intention of the present bill to set up business in competition with existing enterprises."

I do not know whether we are stepping on the toes of private enterprise. I need some information along that line.

Just what did you have in mind when you made that statement?

Mr. MACK. A new monolithic, I believe, is the word Senator Humphrey used this morning, a large central agency to do or even to duplicate the work of other abstracting agencies now in existence. That is what I had in mind, going into business when it is already being done. That is what I had in mind.

Senator MARTIN. Is there such a development that we must survey the field of development to avoid stepping on toes, competing with existing private enterprise?

Mr. MACK. That I would certainly suppose would be part of the function, at least at the beginning, of an institute as suggested this morning, a Federal coordinating agency; yes.

Senator MARTIN. There is no real need for entering into a competitive operation.

Mr. MACK. No, sir.

Senator MARTIN. That is important for me to know. I need a lot of information along this line before I know just what our problem is.

Senator HUMPHREY. May I just try to clarify this then for my thinking? Are you testifying to the effect that there are at present adequate services and facilities, or at least potentially adequate services and facilities in the field of indexing and abstracting?

Mr. MACK. Certainly that is true in chemistry, it is true in biology, it is true in physics, it is true with the American Society for Metals now.

Many fields do it. I dare say they are not all adequately covered, but I would think that they will be in a few years, even without this testimony here.

Senator MARTIN. In other words, there are two dimensions to our problem as I see it. No. 1, find out whether they are presently adequately covered, or not adequately covered, and if they are presently inadequately covered to help attain adequate coverage without any Federal competitive activity.

Mr. MACK. Both of those are true.

Senator MARTIN. If both of those are true, what do you think the Federal Government or this committee or any agency of Government might do to be of help in abstracting and indexing then?

Mr. MACK. I do not know how the people at Chemical Abstracts would react. If their problem is the size of their staff, then perhaps subsidy, if that is the problem, could enlarge their staffs so that their abstracts could be brought out more promptly.

Senator MARTIN. As I see it, you are saying that they have adequate facilities, but there is still a lag at times?

Mr. MACK. I do not know that they have adequate facilities, Senator. Their job is beautiful. It merely does not come out fast enough to keep me satisfied.

Mr. REYNOLDS. May I inject there is a lot of difference of opinion about the sufficiency of that, but representatives of Chemical Abstracts will be here as well as representatives of other such services,

such as Biological Abstracts. The real difficulty is that the instructor in science in the universities and technological institutions and the individual scientists cannot afford to subscribe to these services, as good as they might be as in the Chemical Abstracts. That is the big problem. The Government may have to subsidize this type of distribution if nothing else.

Senator HUMPHREY. I say that there are several layers of discussion here, and several approaches to this problem, and neither Senator Martin nor myself nor Senator Thurmond nor Senator Lausche has any really preconceived, set panacea or solution to this. We are just asking questions and I am following up from the very fine questions that Senator Martin asked. With reference to the Chemical Abstracts, you purchase that service as a library; is that correct?

Mr. MACK. Yes.

Senator HUMPHREY. You would make that service then available to the persons utilizing your library facilities?

Mr. MACK. That is correct.

Senator HUMPHREY. That would, of course, be the community of Lehigh University and I suppose others that come in contact with the Lehigh University?

Mr. MACK. That is true.

Senator HUMPHREY. Do most university libraries and public libraries have these services available?

Mr. MACK. Certainly all universities would have them as a matter of course.

Senator HUMPHREY. All universities would?

Mr. MACK. Oh, yes.

Senator HUMPHREY. So the problem there of an instructor or a scientist at your university obtaining these abstracts at modest cost or no cost has been obviated or has been set aside by your subscription to them.

Mr. MACK. That is correct.

Senator HUMPHREY. Now in private work that would possibly be somewhat different, I mean in a private research capacity. An individual scientist or the group scientist might very well have to subscribe on the basis of an individual or small group?

Mr. MACK. That is right.

Senator HUMPHREY. But in most instances would it not be that a library service would be available to the area served, not only the university area but the whole city of Bethlehem, Pa.; is that not correct?

Mr. MACK. That is correct also.

Senator HUMPHREY. And for the industries of Bethlehem?

Mr. MACK. Private consultants come in and use it if they wish.

Senator HUMPHREY. I personally have not come to any conclusion about how the Government might best effectuate an improved program or what the role of the Government might be. Even though we have a bill before us which lays out some general outline of what we could consider, this bill is not necessarily the final product of our thinking.

It is a beginning. It is an approach. It opens the door for us to explore. Now let's say with this lag which you have indicated in Chemical Abstracts, despite the excellence of its service as a technical competence, would it be possible that the Government might through a

contractual relationship with Chemical Abstracts be able to stimulate further activity and greater output on a more current basis?

Mr. MACK. There is a letter here by Mr. Crane, I believe, in Senate Document 90. He has, as I understand it, had to strike a balance between the competence and the promptness with which Chemical Abstracts is issued.

I do not see how the competence can be improved. I do see that perhaps if his problem is the size of his staff, a contractual arrangement or subsidy to his staff or for his staff could improve the promptness.

On the other hand, I do not see why any university would need to ask the Federal Government for a subsidy to it. That would not attack the problem.

Senator HUMPHREY. You go right ahead on this. This matter of the machine literature searching gets back into the pilot-project area again that has been discussed.

Mr. MACK. Yes, that is right.

Senator HUMPHREY. What is your feeling with reference to a pilot project which within its very terminology would indicate a very expensive operation, at least at a pilot level. Would there be a need for any type of Federal cooperation in the terms of financing?

Mr. MACK. Probably, yes. We have looked at it. Lehigh University looked at the ASM project with a view to transferring it for example, to the digital computer at Lehigh University. It does not happen to fit. Somewhere in the works there must be a digital computer either on the drawing boards now or in existence already which will take this system.

We do not have it, and we cannot afford to buy another computer to handle it. As I suggest, if and when a high speed digital computer is practicable, I believe I would prefer to purchase their service. If a pilot project is necessary, we would certainly be interested in cooperating in such a pilot project. I think it would take a lot of money. We could make a contribution. I doubt whether all the academic libraries in the country put together could make a sufficient contribution to carry it along.

Senator HUMPHREY. This is the kind of a thing, the kind of a project, that I am envisioning that might be under contemplation or consideration by some sort of a coordinating advisory council or board wherein you set out an objective with specific goals, or as one of our witnesses said, you blaze a path which you would like to follow. And in that once having set out those objectives, it may require a cooperative financing relationship on the basis of private, local, and State, public or university type operation plus Federal support.

It seems to me that we get a few specifics like this and we have something to put our teeth into.

Mr. MACK. I am sure that it will require such cooperative financing, Senator.

Senator HUMPHREY. Proceed.

Mr. MACK. Third, foreign language translation.

There is a great deal of activity in American colleges over the importance of the Russian language as a scientific tool. It seems obvious that our research students, that is the present generation of students, will have to be able to handle it in addition to the more traditional German. But until a substantial number of them have developed

proficiency in it, and have actually entered upon their research careers, we must provide translations of Russian scientific publications for our working scientists. Here again competition has muddied the waters. There seems to be a Klondike gold rush on among a number of entrepreneurs, with rates to match.

I should welcome any more to eliminate wasteful duplication of effort, to set up standards of quality, and to provide prompt translations of Russian scientific journals at reasonable prices.

Senator HUMPHREY. May I interrupt?

Mr. MACK. Yes, sir.

Senator HUMPHREY. I have on my copy here a little footnote and I wondered about your testimony relating to the translations of Russian scientific journals at reasonable prices and the testimony of the preceding witness. We indulged ourselves here for quite a little while in a discussion of this. What is your view about that? I noticed your footnote, that the Consultants Bureau, Inc.—is that the Pergamon Institute, is that the same thing?

Mr. MACK. No, sir. Captain Maxwell represents the Pergamon Institute.

Senator HUMPHREY. Yes.

Mr. MACK. My view on it is, we have got to have them but we cannot afford $20 per thousand words.

Senator HUMPHREY. What is the Pergamon Institute?

Mr. MACK. I believe their prices are far below Consultants Bureau. They are, as a matter of fact, I believe subsidized by—is it the National Science Foundation?

Senator HUMPHREY. They are subsidized by the National Science Foundation?

Mr. MACK. I believe so. At any rate, they are subsidized so that their translations are within financial reach of academic libraries.[1]

Senator HUMPHREY. My point with the preceding witness wasn't whether or not the Federal Government should translate. The main thing is to have somebody who can speak Russian and who understands the subject covered by the publication which is to be translated.

Mr. MACK. I agree with that position. I do not agree with Captain Maxwell on that. We have got to have people who speak Russian. Until they come along in sufficient numbers we have got to have translations.

Mr. REYNOLDS. I think what Mr. Mack means by subsidizing Pergamon Institute is that they may have a contract with the National Science Foundation or other groups which may receive support from the NSF in some fields of translation.

Senator HUMPHREY. Here again I want to repeat my own personal position. I do not believe it is necessary for the Federal Government per se to have translators of Russian scientific journals, but I do think it is necessary that some arrangements be made either by private institutions or universities or the Federal Government working in cooperation with other institutions to get this material, where it has real scientific value, translated and indexed and get a bibliography on it, at least a bibliography on the more important papers and some translations where they would serve a useful purpose.

[1] In this connection see letter dated May 6, 1958, from Dr. Burton W. Adkinson, head, Office of Scientific Information, National Science Foundation, to Mr. Walter L. Reynolds, staff director, Senate Government Operations Committee, p. 102.

If this requires a Federal contract with some good established institute or some good established library, that is O. K.

Mr. MACK. Senator, my experience bears out your personal view on that. I think you are correct.

Senator HUMPHREY. Would you say it was most important to have the index?

Mr. MACK. First of all, yes, oh, yes.

Senator HUMPHREY. If we had a list of priorities here and we have only a limited amount of funds, and manpower to utilize, the first thing would be the index; is that right?

Mr. MACK. Yes, sir.

Senator HUMPHREY. The bibliography?

Mr. MACK. That is correct.

Senator HUMPHREY. Even before an abstract?

Mr. MACK. Yes, sir.

Senator HUMPHREY. You would almost put it down in the sequence of index, bibliography, abstract, translations?

Mr. MACK. I would, yes, that is right.

Senator HUMPHREY. Would that be about your view of the sequence?

Mr. MACK. I want to be able to put my finger on the abstract at the very least, but first of all, the index.

Senator HUMPHREY. I believe that was the testimony of Mr. Hilty. Thank you.

Mr. MACK. At any rate, the academic library is a consumer, or at least a customer; and again it would appear that centralized coordination is one of the first steps to be taken.

The bill under consideration here appears to provide adequate means for such coordination. It is my guess that the cost of producing translations will have to be subsidized; and I might suggest in passing that certain features of the Depository systems of either the Superintendent of Documents or the Atomic Energy Commission might fit the case admirably.

Up to this point in my testimony I have referred only to the consumer role of academic libraries. Collectively, these libraries may indeed be looked upon as a vast pool of scientific information, or as a network of storage depots. They are certainly a great national resource.

Senator HUMPHREY. Can I interrupt you again?

Mr. MACK. Yes, sir.

Senator HUMPHREY. I am just going to school with you this afternoon, sir. Does the Library of Congress have a complete tabulation of all the material that is in your Library?

Mr. MACK. I think it is probably complete up to last week or so.

Senator HUMPHREY. That is what I mean.

Mr. MACK. I think so.

Senator HUMPHREY. In other words, you are a depository library; aren't you?

Mr. MACK. Yes, sir.

Senator HUMPHREY. The Library of Congress would have at least an effective and efficient way of being able to ascertain on very short notice the material that you might have in a particular scientific area.

Mr. MACK. In their National Union Catalog, that is correct.

Senator HUMPHREY. So we do have some system of coordination already at the Library level.

Mr. MACK. That is correct.

Senator HUMPHREY. And that affects or relates to all the depository libraries; doesn't it?

Mr. MACK. Not the depository libraries of the Superintendent of Documents, Senator. It is the libraries which submit copies of their catalog entry cards as they are produced locally to the Library of Congress.

This is not related to the depository system of the Superintendent of Documents.

Senator HUMPHREY. I see. Do most of the university libraries submit their cards?

Mr. MACK. Yes, sir.

Senator HUMPHREY. And most of the large public libraries?

Mr. MACK. Oh, I would think the largest ones; yes.

Senator HUMPHREY. I am just learning you know.

Mr. MACK. Yes; I realize that.

Senator HUMPHREY. It has been a long time since I worked through those card indexes. I hate to confess it, but it has been a long time. Now, you said back here a moment ago that there were certain features of the depository systems of either the Superintendent of Documents or the Atomic Energy Commission that might fit the case admirably. What do you mean by that? I slipped over that as though I knew what you were talking about, but I didn't.

Mr. MACK. The deposit system of the Superintendent of Documents furnishes academic libraries or public libraries, also, with certain documents published by the Federal Government.

Senator HUMPHREY. Yes, sir.

Mr. MACK. In some cases, they furnish all public documents. In our case, for example, we are a selected depository at no cost, but with certain obligations, including the obligation to make these as fully available as any other material in the library, and not to discard it without permission from the Superintendent of Documents. There is, I believe, in 95 percent of the cases no direct charge to the libraries for these documents. They cost a fair amount in overhead to catalog and handle, but the return of that in availability certainly justifies the expense.

Senator HUMPHREY. So, what you are saying is that when these translations will be made available, even under a Federal-type subsidy program, that they be made available on a selected basis to the depository libraries or as under the depository libraries as the Atomic Energy Commission makes available declassified materials to you.

Mr. MACK. And I would be willing to undertake certain conditions or obligations set down for these translations.

Senator HUMPHREY. Thank you, Professor.

Mr. MACK. They are a national resource. However, I would not wish to leave the impression that academic libraries are merely passive in their function. The fact is that scientists in academic institutions, in industry, and in Government look upon academic libraries as suppliers of information whose first duty is to help them to exploit the published record with a minimum of fuss and bother.

There is, incidentally, an acute shortage of competent science librarians in this country, and, if I may, I should like to suggest that the provisions of title III (on scholarships and loans) might be ex-

tended in an attempt to remedy this handicap. At any rate, through a vast, but informal, system of interlibrary lending in constant operation, information in any one library is readily available to scientists everywhere. You touched on that a minute or so ago.

Senator HUMPHREY. I want to ask Mr. Reynolds to be sure that that passage on page 4, relating to the provisions of title 3 and the recommendations on scholarships and loans for science librarians, be transmitted to Senator Lister Hill, because they are getting ready to take some action on that national-defense education bill in which there is considerable aid in the field of scholarships. I think you are right about this; that we ought to put some special emphasis on these science librarians.

You would agree with that; wouldn't you, Senator Martin?

Senator MARTIN. Yes.

Mr. REYNOLDS. The staff report points out that that area will probably be handled by the Labor and Public Welfare Committee, since they are considering a much broader program in scholarship loans and grants than this bill contains.

Senator HUMPHREY. Right.

Mr. MACK. Well, there is this system of interlibrary cooperation now in operation. This system might be improved in several ways, but the point is that it already exists as a means for disseminating information, and it can, thus, materially supplement the work of the Bureau of Technical Services, as I read S. 3126.

I have been watching with great interest the development of the new National Science Lending Library now being organized in Great Britain under their Department of Scientific and Industrial Research (DSIR). The aims of that library are similar to certain features of the present bill, and I would urge that the possibilities of active cooperation with this British counterpart be explored as soon as conveninet.

I should like to make one further point in this connection to conclude my statement. The Science and Technology Act of 1958 may become law, or the Federal Government may eventually sponsor a coordinated scientific-information program in another context. In any case, I should say, on behalf of scientists, engineers, and librarians alike, that the national interest demands an absolute minimum of controls over the national and international flow of scientific information.

I am referring to all such information in general, and to the results of Government research in particular. Impediments to this flow, however slight, and however justified in terms of either national security or economy, are flatly inimical to the premises and purposes of academic life.

The fact that they complicate the work of librarians is, perhaps, the least of their evils. I think it safe to say that academic libraries can and will adapt their point of view and their practices to any national system, providing that system encourages and contributes to the freest possible dissemination of the literature of science.

Senator HUMPHREY. Very helpful, indeed.

Any questions, Senator Martin?

Senator MARTIN. Let's go back to the point earlier in your testimony about whether we can move in this field without stepping on the toes of established services. We clearly should not stage an onslaught

on adequate established services. On the other hand, we do not want to step out of the picture entirely, just because there is some effort at making some service available now.

We are in between two fires in that regard. We need more information, certainly, than I have at present as to where the proper field for applying this presently considered program is, where we would be in proper bounds in moving into the field, where it would be better to consider subsidizing existing services, and where the need is greatest. We need a lot of light on that before I will be in a position to pass judgment on the program we now have before us for study.

Mr. MACK. Senator, my only comment on that is that a National Institute of Documentation setup, perhaps under the wing of the National Academy of Sciences or National Research Council, might serve as a coordinator. Certainly, if that were the case, they might ask the Federal Government for funds to subsidize. I am quite certain that they would not want to step on anybody's toes, want to move into areas of work where existing agencies can cover the situation.

But if there is any way that a quasi-governmental agency can aid by encouraging, let us say, science libraries to come into the field, by subsidizing the staff of Chemical Abstracts, for example, subsidizing translation projects, then I don't see that the Federal Government is stepping on anyone's toes. I think that they would be able to do it on that basis.

Senator MARTIN. In those fields we would be relatively safe.

Mr. MACK. From that point of view; yes, sir.

Senator MARTIN. In encouraging expansion.

Mr. MACK. I think it would be effective, too.

Senator MARTIN. I have no further questions.

Senator HUMPHREY. Thank you very much, Mr. Mack. We are very grateful to you for your cooperation and your very informative testimony. We might call on you again.

Mr. MACK. Thank you again, sir.

Senator HUMPHREY. Thank you, too, for staying with us.

Mr. MACK. Not at all.

Senator HUMPHREY. Mr. Julius Stulman.

(Letter referred to on p. 98 is as follows:)

NATIONAL SCIENCE FOUNDATION,
Washington, D. C., May 6, 1958.

Mr. WALTER L. REYNOLDS,
Staff Director, Senate Government Operations Committee,
Senate Office Building, Washington, D. C.

DEAR MR. REYNOLDS: I certainly appreciate your sending me the transcript of the first day's testimony on the development of information concerning the Government's participation in assembling, abstracting, and dissemination of scientific information.

I will try to gather the information regarding the Pergamon Institute and send it to you soon. I will also investigate sources of information about the establishment of a World Institute discussed by Mr. Julius Stulman in his testimony.

For your information I believe that Mr. James D. Mack, librarian of Lehigh University, had been misinformed that the Pergamon Institute is subsidized by the National Science Foundation. The Foundation has no direct relationship with either the Pergamon Instutute or the Pergamon Press. The Foundation has made grants to professional societies and universities for the translation of scientific journals, and some of them, such as the Massachusetts Institute of Technology, have contracted with Pergamon Press to translate and publish journals, for which the university requested funds from the National Science Foundation. The Pergamon Institute and Press, in some of their releases as well as notices in their bulletins in journals, have worded their statements in such a

way that one would be led to believe that there was direct cooperation between the Foundation and Pergamon Press.

It might be of interest to you to know that we have arranged for grants to professional societies and universities for translation and publication of journals for the following two reasons: (1) These institutions are in a better position to select the Soviet material that should have priority consideration for translation; (2) within their organizations they have both linguistic and technical competence to check the quality of the product. The Foundation cannot hope to have competence in all languages and in all subject fields. Our staff must rely on these scientific societies and universities for this type of advice.

I want you to know I found the first day's hearings very interesting, and some very useful information was provided by the witnesses. I hope that the testimony on the following days will do much to clarify in everyone's mind the course of action that seems wisest to take in order to give the scientists and engineers of this country information in both United States and foreign science and technology which they need in pursuit of their research and development activities.

Sincerely,

BURTON W. ADKINSON,
Head, Office of Scientific Information.

STATEMENT OF JULIUS STULMAN, PRESIDENT, STULMAN-EMRICK LUMBER CO., BROOKLYN, N. Y.

Senator HUMPHREY. Mr. Stulman, we are very pleased to have you with us.

Mr. Stulman is the president of the Stulman-Emrick Lumber Co., Brooklyn, N. Y.

Just proceed according to your own desires, sir.

Mr. STULMAN. Thank you very much.

Senator HUMPHREY. Do we have a copy of your testimony? Oh, yes; we have it. Thank you very much.

Mr. STULMAN. I was misinformed as to the length of preparation. I only have a short outline, but I will continue from there.

Senator HUMPHREY. You proceed here.

Mr. STULMAN. I am here because of my interest in the work of the Western Reserve University's documentation program, which I consider essential and vital. I am concerned with it because it is a very necessary organ in the further development of this country's science and research.

I doubt whether we can make any notable progress without this or similar documentation service—my only quarrel with the program, as stated in the record that Western Reserve University has submitted, is that it is too modest and is taking too long to accomplish—we haven't the time—money in this instance is not the equation.

These documentation centers must be established, and, as quickly as possible; since there is no other means than the Government readily available at this time to encourage and establish quickly this necessary and fundamental source of synthesized documents and facts to serve the country and the world, it should be implemented by the Government, and be accomplished as quickly as possible.

It is insufficient to just accumulate facts. We should establish new and adequate methods of application of the available knowledge. I am further interested in the documentation center because it is a very necessary part of a proposal called the World Institute, which I wrote in 1941.

The World Institute was developed, not in a spirit of contest with Russia, or because we had been "sputniked," but, rather, it is an

outgrowth of the desire to help solve our social, political, economic—national and international—problems.

It is a methodology which has found favor with some of the top thinking men in many disciplines—in our country and abroad.

The fact that the thinking has been confirmed since its inception and is being confirmed in many quarters and many fields and its need being highlighted by the establishment of this very committee, further qualifies its value. It is a direct and constructive answer that can probably meet the challenge that we face, vis-a-vis Russia.

We have no time to waste before the implementation of the thinking that it indicates is put in practice; if we, in the United States, are unable to continuously develop and grow and others in the world find ways and means of extending rapidly their knowledge and science and its application, we, indeed, become a have-not nation at once; in fact, an underdeveloped nation.

I also am here because this committee and its actions, in my opinion—and, I am sure, yours—will, without doubt, be considered historic, for this is the beginning of a new era, and how this committee conducts itself and applies the best thinking available in establishing procedures and fundamental policies under which we shall go forward may well determine the fate of the Nation.

For this is the age of ideas, and we are searching for new formulas, having ended the age where matter can be created and easily destroyed in the formula "E equals MC^2."

We need to create new formulas and methods to bring man and mankind forward, so that we can cope with the tremendous forces that we have let loose in the world.

I would like to submit a memorandum here, called the World Institute, in relationship to the information service center, which was prepared by the Western Reserve in connection with how their thinking and mine dovetail, and may I read a letter I received from Donald Faulkner, vice president of the Western Reserve University. [Reading:]

Dr. Kent just left my office after reading the first page of this issue of Insights, and remarked on the identical ideas of their plan for the creation of a National Center for the Coordination of Scientific and Technical Information.

When I told him that I had been reading and discussing these selfsame ideas with you for more than 10 years and that, of my own knowledge, you have been formulating and promulgating such a synthesis since 1941, he was, of course, excited, to put it mildly.

I should like to submit the World Institute, as proposed to the Foundation for Integrated Education in January 15, 1949, a proposal for a scientific institute devoted to research and action for the integrated human and economic development of the world.

Senator HUMPHREY. May I see a copy of that letter? Undoubtedly, one of the United Nations organizations, such as UNESCO, must do something like this. I think that would be very important, Mr. Reynolds, that we find out what the U. N. agency does in terms of the dimensions of the project being outlined here on a World Institute basis in particular.

(Off the record.)

Mr. STULMAN. May I read a letter I received from Dr. Albert Einstein in 1949? It is pertinent to our meeting here. [Reading:]

Thank you for your booklet and your letter of November 23. I am in complete agreement with you, as far as the general goal is concerned, orientation of all human endeavor from the viewpoint of security and welfare for all men.

However, I doubt that it would be possible to contribute essentially toward the attainment of this goal by the establishment of an institute of the kind you propose. The reason for my negative attitude is the following:

It is not lack of insight and knowledge which prevents the attainment of our goal. It is the unwillingness of our contemporaries to subordinate to this most important goal all other aims and activities to make the necessary sacrifice for it.

What is needed is an all-out act of will, which cannot be brought about by mere understanding and knowledge of casual interrelations.

If there would be such a will and enough determination behind it, then it would not be too difficult to find effective means.

I am so happy to say that that was 1949, and here we are, a committee reviewing seriously just such proposals.

I should like to just read a thin nontechnical explanation of the institute operation as I proposed it in India. I was asked by Prime Minister Nehru to work with the 5-year planning commission and I had an opportunity while working with them to help them understand the World Institute and to help them set up the World Institute in India in 1951.

This was part of my memorandum then.

What I propose is the creation of a world institute, a voluntary association of the best available brains and skills of all disciplines and spirits dedicated to the integrated, ethical, and material development of man by pooling knowledge and understanding and working together on a cooperative basis.

I am not talking about creating just another learned academy, another research foundation, another intergovernment commission, another world-girdling business enterprise. This World Institute proposed is something of all of these and much more than all of them. Its central purpose will be to break down the compartments that divide human knowledge and human action, and to put the products of integrated knowledge to work wherever men have significant needs they do not properly meet. I would have us create a giant research and managerial brain which would undertake to educate and guide people in gathering and putting to use the best thinking and knowledge anywhere in the world.

We have reached the stage never before reached in the history of mankind where it is actually possible to bring the very best science and technology, the very best wisdom and understanding anywhere on the earth into the service of the lowliest, most remote village anywhere on the earth.

Let us think about that obvious but startling fact. Let us consider its implications for our national and international policies and actions. Let us consider the silent judgment which over against that fact, must be made of our present chaotic, warring world. Political federation and unity the world needs.

An international police force we shall have to create sooner or later, and better sooner than too late. These daring ideas thoughtful men in many lands have come to see and to accept. But I am made bold to say that the pooling and cooperative use of our accumulated knowledge and skill in grappling with the specific social and economic needs of people on a world basis—this is at the heart of the problem of creating harmony and order in the world.

We need an instrument for hacking our way through the barbed wire entanglements which separate our available knowledge and potential understanding from our patterns of action.

We need a means for cutting through the barriers of ignorance, superstition, fear, national greed, and national jealousies. I believe that instrument can be forged. I believe that means can be found.

That is a page and a half of a document.

Senator HUMPHREY. A very worthy project and may I say a very far reaching one and one which I surely would want to encourage, even though I must say that I am a little less optimistic about mankind's willingness to subordinate his passions and his appetites to the public good.

I guess I am getting older, am I not?

Mr. STULMAN. In that connection, I should like to refer to your remark in a moment. I think I have something to say on that. But

in connection with the India report, I have a letter here from an officer of the New Delhi office of the United States Government in reference to the work that was done there and how they accepted it:

I believe your discussions with the Planning Commission have borne rich fruit in the influence they had in the presentation of the 5-year plan which was presented by the Prime Minister to Parliament in most emphatic fashion. It is hard to tell where your ideas stopped and the Planning Commission's began.

I received a letter from Chester Bowles in 1953, and I won't read it, but will just touch on two points in it. This is when he was leaving the ambassadorship:

I discovered in going through my files in preparation for leaving Delhi that I had not answered your letter of June 10, 1952, enclosing a mimeographed copy of the talk you gave at the Earlham College Institute of Foreign Affairs. This lead me to again go through the other reports you sent me, particularly the India report which you prepared in April of 1951. Your reports came to me as a breath of fresh air. If only there were more people who had your clear understanding of the problems in this part of the world and the sensible ways of attacking them.

I was particularly impressed with your ideas about industrial development. I would agree with you entirely that there is no need for India to go through all the painful steps of industrial development that we went through. Instead, they should endeavor to get the latest technical knowledge and put it to use.

Here again I think that we are likely to find that for the most part the technical knowledge is available somewhere in India. However, the difficulty again is putting it into effect and that is where an institute such as you contemplate could help greatly.

Senator HUMPHREY. Senator Martin wishes to direct a question to you.

Senator MARTIN. You have expanded the scope of this hearing considerably in a very short period of time. I understand you have been a student in this field for a considerable time. Would you advise us to await action in this field until we have digested all that you have suggested here and develop this bill to match what you are suggesting, or do you think we should go ahead and take something less in order to get the matter through the Congress before adjournment?

Mr. STULMAN. Well, you are asking me a tall question.

Senator MARTIN. I am talking about a rather tall subject.

Mr. STULMAN. You are, and one so vital that I hesitate to answer quickly, for I take very seriously the situation in which we find ourselves.

First, because I recognized its coming so long ago, and saw its markings to the present, recognized the need for gathering this information and the power of its use, recognized what the significance is of the world brain that we are going to create. Here we sit listening to technical details about science when, in effect, what is happening is that we have reached a completely new era, so completely new that everything that we discussed is already antiquated.

We are dealing with the errors, and we must not propound and compound them by mere size. More facts and more scientists and more science laboratories and more research will not avail the answer.

We have to learn some new laws and some new principles and begin to apply them to our knowledge. We have to understand the processes of thinking. We have to call upon all the disciplines at this time to create something powerful enough to offset this great power we have let loose in the world. We have nothing. One man is not capable of standing up against this awesome power, and we in a free world,

insisting upon our freedom, must devise and create and understand and implement new thinking, completely revolutionary thinking.

And it is possible that it is here, because man is not really man. He is mankind. Now that is a tall order and will take a great deal of discussion. Man does not think in compartmentalized ways. This is our problem. Too long have we been "spoke makers" piling up sticks upon sticks. We have now got a hub: E equals mc^2—and thereby can fashion a wheel for function, and no longer remain "spoke makers," gathering facts.

Senator HUMPHREY. What does that mean?

Mr. STULMAN. E equals mc^2, energy by the square of light. That is Einstein's formula, energy equals matter by the square of light.

Senator MARTIN. I don't want to intrude here. I do have an appointment and I have got to go. I am glad to have your further statement.

I will give it a considerable amount of thought, but I don't know whether Congress is going to be patient about waiting until I understand this whole field thoroughly.

Mr. STULMAN. Then I will say this: This is not a new subject with me, and I am thoroughly convinced that this is a methodology, because we need a methodology. We need a completely new approach to all our thinking or we are going to compound our errors.

We have to understand that. For instance, the definition of the word "practical" is to deal with error, but we must understand that we are dealing with error and that is our failure.

Senator HUMPHREY. Mr. Stulman, I am philosophically bent myself and I have one of these sort of inquisitive minds about these things. I would love to stay with you, but the truth is, I have got to hold you to the subject matter before us.

Mr. STULMAN. It is not so much philosophy as fact.

Senator HUMPHREY. No; it is fact, I realize that, and I know that you have put a lifetime of work into it and I admire you and respect you for it, but I do think that our issue—which surely fades into insignificance in terms perhaps of the broader problems—now is whether or not the existing system or methods that we have of correlating, disseminating, retrieving, indexing, translating, and so forth, valuable scientific materials and documents is adequate, and we have a provision in the bill that we have asked to receive testimony about that which relates to this, and I want to know what your views are other than what I have heard.

Mr. STULMAN. They are just what I have stated. I can only repeat I don't see how we can do otherwise, but to have it, because we will learn that we have to stimulate creative thinking, and the basis of creative thinking, if I may, in my opinion, operates like this: First, you gather all the facts together you can get, and then, of course, you limit it to your own inability to gather these facts.

Then again you are limited to your ability to interpret them. And then how in the world do you know you have got them all?

And then when you have them, what have you got, because there are no facts. They are all completely transitory. It is not philosophy here. These are facts, because when you go back even 50 years, we will find that 85 percent of what we called facts then are false now, and so how much is false now?

And so these are facts.

Now, if that is our beginning point, then why accumulate facts? But that is essential. It is a vital, because it is the process of thinking.

After we get these facts together, we make an interpretation of them, and then an evaluation of them, and then it is synthesized subconciously for creative thinking. Then it is synthesis of humankind. Now, this is the process. Without these facts, however, you are lost, because you must catch them across the fields. Biology must speak to physics and physics to philosophy.

Senator HUMPHREY. I think we realize that. I think that was emphasized here in the testimony even in the field of metallurgy, how biochemistry was involved, and how the organic chemistry became involved. I think we realize this interdependence, and I will surely concur with you that one of the weaknesses of our present society as it is manifested particularly in Government, and Government has a way of transmitting its image down into other institutions, is the compartmentalization.

We are training people like this now. You know we train people just to be experts in fingernails or experts in the right wheel of a four-wheel automobile or the spokes of a bicycle front wheel.

Some of the trouble is, I feel, in this field of science—and this is just a layman talking—that there isn't any general practitioner and we are short conductors. We have got a lot of instrument players.

Mr. STULMAN. Yes.

Senator HUMPHREY. It is knowing the full score.

Mr. STULMAN. I still complain it is very vital and essential, and I would like to leave some other material pertinent to the application, the practical application of what I am talking about.

Senator HUMPHREY. Very good.

Mr. Reynolds is our staff director, and I am going to ask him to get in touch with you. I have to conclude this. We are going to have hearings that will continue on May 6, at 10 a. m., room 212, Senate Office Building, May 7, 10 a. m., room 357, this room, Senate Office Building.

If we are unable to accommodate all the witnesses who have indicated a desire to participate in these scheduled hearings, it may be necessary to continue them through Thursday, May 8.

In case that happens, there will be somebody else presiding, because I shall be onward and forward to Minnesota to celebrate its centennial on May 8. We are going to celebrate considerable scientific progress, gentlemen.

Really, the information transmitted to the subcommittee today has been very, very good, and I again wish to thank those of you who have participated with us.

(Whereupon, at 3:55 p. m., the committee adjourned to reconvene at 10 a. m., Tuesday, May 6, 1958.)

(Communications received by the subcommittee and answers thereto, placed in the record by direction of the chairman, are as follows:)

APRIL 22, 1958.

Memo to Walter Reynolds.
From Senator Hubert H. Humphrey.

I wish to share with you excerpts from a letter from a very distinguished doctor at the University of Minnesota, Dr. Frederic J. Kottke, director of the medical school at the university. May I suggest that you drop him a note thanking him

for his observations. He is very highly regarded and has outstanding professional competence.

The excerpts are attached.

[Excerpts from a letter dated February 4 from Dr. Frederic J. Kottke, to Senator Hubert H. Humphrey]

"On the political side, just as in olden times, I cannot refrain from offering you sage, and probably useless, advice. I have been concerned about the narrow view that, because of the sudden importance of sputnik, a Department of Science should be established with a Cabinet status. I refer to this as a narrow view because I do not think it encompasses the whole problem. It again represents, I think, our attempt to streamline out production and activities into applied mass production rather than taking the broader, longer range, more productive view. What I am suggesting is that instead of a Cabinet Department of Science, it should be a Department of Scholarship that encompasses the whole field of knowledge, study, and research. I know that you are as well aware as I am that we are as deficient in our knowledge of social sciences as we are in our knowledge of physical and biological science. We have just as much progress to be made in the development of our knowledge of human behavior and human relationships on the individual and group bases as we have in developing scientific apparatus. I have discussed this problem with a number of my colleagues at the university. They show an equal concern. As a matter of fact, 3 or 4 months ago, Maurice Visscher tried very hard to get in touch with you because he wanted to, at that time, propose the development of an independent Department of Education with status at the Cabinet level for this purpose. As he and others have pointed out, the primary contributions to knowledge have come, in the main, from European schools. This is because the scholarly career is a laudatory profession in Europe. Scholars in Europe are not under the gun to produce world-shaking discoveries every year to be published in the annual report with 40 copies. On the other hand they are allowed to do what is necessary in formulating and developing new ideas, to study and think and plan and test over the period of time necessary for production. In the long run, this is the way that new ideas are developed. We have, until recently, excelled in the streamlining, mass production, and application of the ideas developed by others. Today it is very questionable that we even excel in this area since the Russian Government is now competing with American industry in application and development. On the other hand, the Russians are also supporting basic research and giving men of ability a chance to do research over a prolonged period of time without demanding progress reports which probably interfere with their ability to organize and develop long-range programs. The Americans do not even have a word for the science of scholarship. The Germans call it wissenschaft. Our closest word is scholarship but it does not really imply the breadth implied by wissenschaft.

"Another reason for having a Department of Scholarship instead of a Department of Science is that we never know where the next advance in knowledge will be be made. We do not know when knowledge developed in one area will find application in another area. Fifty years ago the outstanding physicist in the United States announced that there was nothing more to be learned. Twenty years ago the experiments in physics were widely denounced as a waste of time and there was a trend in the schools away from mathematics and physics to the teaching of adjustment to living in society. What the next great development will be I do not know but it is probably in an area which today is being disregarded or even repressed. All of our past history demonstrates that the search for knowledge need be conducted on the broadest possible scale if we are going to make progress. It is for this reason that I would urge that the bill for a Department of Science be broadened to a Department of Education or Department of Scholarship in order to provide this breadth."

APRIL 29, 1958.

Dr. FREDERIC J. KOTTKE,
Director, the Medical School,
University of Minnesota, Minneapolis, Minn.

DEAR DR. KOTTKE: Senator Hubert H. Humphrey has submitted to the staff of this committee extracts from your letter addressed to him under date of February 4, 1958, which pertain to the various proposals incorporated in the draft of the Science and Technology Act of 1958. He suggested that this information be incorporated in the committee's files in order that appropriate consideration may be given to it when hearings are scheduled on the bill, S. 3126.

As you will note from Senate Document 90, a copy of which has been forwarded to you, consideration was given to the various points you raised in your letter. For instance, your suggestion relative to the desirability of creating a Department of Science and Education was discussed by the staff with a number of scientists and Government officials, and the reaction, in principle, is set forth by Dr. Wallace R. Brode on page 20. Also, this committee gave extended consideration to the problems relating to Federal aid to education in connection with hearings on bills proposing the creation of a Department of Health, Education, and Welfare as far back as the 80th Congress. At that time there was considerable support for the creation of separate departments of health and of education. As you know, this was finally resolved through combining these functions in the Department of Health, Education, and Welfare. Comments on this phase of the proposed new program on science are set forth on page 13 of the Senate document.

As is set forth on page 51, there are a number of bills which relate specifically to science and education, support of Federal grants-in-aid to schools and universities, and scholarship grants pending before the Committee on Labor and Public Welfare. Copies of the hearings on these bills, which extended from January 21 through March 13, 1958, may be procured by addressing a request to Mr. Stewart E. McClure, chief clerk, Senate Committee on Labor and Public Welfare, United States Senate. The title on educational loans was included in S. 3126, as an essential part of the proposed Science and Technology Act, limited only to the physical and biological sciences and to mathematics and engineering. This is only part of the program which will be considered by the Committee on Labor and Public Welfare, however, which has jurisdiction over legislation dealing with education generally.

As has been repeatedly set forth in Senate Document 90, the proposals included in S. 3126 were prepared by the staff for consideration by the Congress, and, until the committee has considered such proposals and established its own policy regarding the various provisions contained therein, they will not be considered by the Senate. The bill has now been rereferred to the Special Committee on Space and Astronautics for consideration, and, except for those provisions which relate to the assembly and distribution of scientific information, as set forth beginning on page 178 and in the statement released by Senator Humphrey, which is attached, this committee will defer any consideration of other provisions until the Special Committee on Space and Astronautics has completed its hearings and submitted its recommendations to the Senate.

Sincerely yours,

WALTER L. REYNOLDS, *Chief Clerk.*

UNIVERSITY OF MINNESOTA,
THE MEDICAL SCHOOL,
Minneapolis, November 6, 1957.

Senator HUBERT H. HUMPHREY,
Senate Office Building, Washington, D. C.

DEAR HUBERT: I have finally assembled some names to fulfill your request of October 24 for people who could make a contribution to the problems of the Government's scientific efforts. They are as follows:

1. Dr. Maurice B. Visscher, head, department of physiology, University of Minnesota Medical School, Minneapolis, Minn.
2. Dr. William T. S. Thorp, assistant dean and director, School of Veterinary Medicine, University of Minnesota, St. Paul Campus, St. Paul, Minn.
3. Dr. Alfred O. C. Nier, professor and chairman, department of physics, University of Minnesota, Minneapolis, Minn.
4. Dr. Izaak M. Kolthoff, professor and head, department of analytical chemistry, University of Minnesota, Minneapolis, Minn.
5. Dr. Owen Wangensteen, professor and head, department of surgery, University of Minnesota Medical School, Minneapolis, Minn.

There are undoubtedly many others and I shall be happy to find more names if you need them. However, these people, as you know, are well acquainted with the situation and are quite able in their own right to express themselves on a particular problem. You may not be personally acquainted with Dr. Thorp who has served previously with the United States Public Health Service and is well acquainted with the problems of Government. He is for example, one of the advisers to the Atomic Energy Commission and supervised the experiments on animals used in the atomic bomb testing program. Dr. Visscher, with whom you of course are very well acquainted, currently has a grant from the United

States Public Health Service for the purpose of studying the situation as regards science training in high schools and the subsequent problems encountered in the colleges as far as enrollment and advanced training in colleges is concerned. Dr. Kolthoff was very instrumental in the program of developing synthetic rubber during the World War II and knows many of the problems encountered in this program as it relates both to Government and the availability of competent scientists.

Dr. Owen Wangensteen, as you know, is a world famous surgeon but is also well acquainted with the United States Public Health Service program and also is well acquainted with the lack of competent scientists in the field of medicine. These are representative people of the areas I believe easily available here at the university. I assume that your other contacts will give you names in their respective departments.

I should like to take this opportunity to add one or two ideas of my own which I have attempted to discuss with you during your visits to Minnesota. As you recall, I had a contract to conduct a research program with the United States Air Force School of Aviation at Randolph Field, Tex. This was an attempt to conduct a basic science project sponsored by a military agency. I believe this was probably typical of many of their contracts and can be used as an example. First of all when submitting a proposal for such support from Randolph Field it is necessary to insert a section explaining the "practical" application of this project to present-day military operations. I have no objections to development programs dealing with present-day operating problems. However, if the project is listed as a basic science project supposedly intended to produce new information, the practical application restriction is then difficult to circumvent. Second, nearly all the projects of this nature supported financially by the military agencies are controlled by military personnel. It is not my intention to discredit military personnel in any way. They are trained by tradition and current expediency for the purpose of military operations nearly always with the end result of physical destruction of property and human life. The fundamental point here is that people trained for this purpose are then expected to understand and supply intelligent direction and administration to a basic research program. As I understand it, the military agencies are able to acquire huge budgets from Congress primarily due to the necessity for military preparedness. To my knowledge there is no scientist who would dispute the necessity for such a program. There is only one efficient solution that I can see to stimulating and accelerating basic science research and training. This would be possible only by separating the operational and development programs of the military agencies from basic science. This would mean either to establish a new agency or to use the existing agencies such as the National Science Foundation, the United States Public Health Service, and similar groups established within the Government able to conduct such a program. For example, I read in the newspapers that the Secretary of Defense recently returned to the budget $171 million to the defense budget for basic research. I call to your attention that this is approximately 4 to 5 times the total budget of the National Science Foundation. It seems to me a sorry state of affairs when an amount which is just "peanuts" to one agency is several times the total budget of another agency established for that particular purpose.

Finally, it seems to me that the most efficient use of Federal money for the promotion and acceleration of basic research and the production of scientists must be done in the institutions already designed for this purpose. These would be the colleges and universities throughout the Nation. I am sure you understand the impact that the $171 million recently juggled by the Defense Department as a minor item would have if spread out to the various universities and colleges for support of scholardhips and scientific research.

Another serious handicap imposed upon nearly every investigator engaged in basic research is the method used to provide grants for support of research projects. Fundamentally the final result is that the scientist must be a "promoter" a large part of the time in order to secure funds to operate his laboratory. The support is then granted usually on a year to year basis depending upon the scientist's ability to sell his ideas to the supporting agency. This results in not only an inefficient use of a highly trained scientist's time but places the research program on a very insecure temporary basis. The secondary problems encountered are for example difficulty in hiring other technical personnel to work on a project which may or may not be continued subject to the attitudes of the Congress, the administration and finally the monitoring personnel of the agency supplying the funds. A further result is that many scientists are reluctant to start the longer

and more complex research program necessary at times to investigate difficult problems due to the uncertainty of financial support long enough to complete a project which may require several years.

I suggest as an immediate step that the Congress appropriate $1 billion to the National Science Foundation for support of basic research, advanced training of scientists, scholarships for promising high-school students interested in science careers, construction of research buildings, and scientific apparatus for elementary schools and colleges. Further, I suggest that one-half of this money be obtained from the Defense Department's budget for their so-called basic research and the remainder to come from an additional appropriation.

The present hysteria over scientific progress is merely a tragically late recognition of what scientists have been predicting for the last ten or more years. I agree that some type of investigation is necessary but immediate action on a magnitude sufficient to make an impact is what is most urgently needed.

Sincerely,

W. G. KUBICEK, *Professor.*

UNIVERSITY OF MINNESOTA,
THE MEDICAL SCHOOL,
Minneapolis, January 30, 1958.

Senator HUBERT H. HUMPHREY,
Senate Office Building,
Washington, D. C.

DEAR HUBERT: I received your very fine letter relating to the basic science problems and also the copy of a proposed bill relating to a new Department of Science. I have enclosed a copy of a letter to you last November 6 which arrived at your office while you were in Minnesota. I do hope you will read over the second and third pages in relation to some ideas I had concerning science. Some of the details concerning the Defense Department are now obsolete but I believe the principles are the same.

The bill which you sent me concerning the development of a new Department of Science has several serious faults.

1. I can see no reference to financial support or assistance to colleges and universities to directly assist them in the expansion of teaching and laboratory facilities and a grant-in-aid program for support of basic science research. As far as I can see the bill reflects a typical Government worker attitude that the Federal Government should establish research facilities of its own around the country and staff these same facilities from the limited number of scientists available. This not only would compete with the existing need for scientists in industry and in the universities for teaching but would present a serious handicap to the teaching institutions. Fundamentally, I have tried many times to impress upon you the fact that the United States has a very extensive system of colleges and universities and that the most efficient use of Federal money would be to strengthen these existing institutions. Money spent in this direction has direct influence immediately upon the ability of these institutions to carry out the basic science teaching and research. Money spent for establishing research centers supported by the Federal Government must first shoulder a huge burden of overhead for administration and operation of physical facilities. Also, the policy of such administration is difficult to determine and a further handicap is the general lack of appreciation of basic science since it does not have a direct financial reward in most cases. This is a point which has been thoroughly expressed in various ways by all scientific groups for many years. It apparently has fallen upon deaf ears since it was quite apparent that President Eisenhower has not grasped the fundamental principle involved. If the language of the bill which you sent me reflects the attitude of the Congress, then it again means that the leadership in the Congress has not understood the basic difficulty which this Nation faces.

2. Another feature of the bill was the reference to the authority for the new Secretary to either establish Government-owned research centers or to support such centers to be administered by private nonprofit institutions. This apparently would automatically rule out colleges and universities except the privately endowed institutions.

3. Another serious error in my mind would be to allow the present provision in the bill to pass which provides that the debt of a student loan will be forgiven providing the individual agrees to work for the Federal Government for a prescribed number of years. If this either was eliminated entirely or would be extended to

any nonprofit institution it would then be of some benefit to the basic science-teaching institutions.

In defense of the bill of course is the obvious advantage of a single department responsible for science and at least an opportunity to improve the policy and efficient direction of these Government-operated agencies.

I believe also you should seriously question whether or not certain portions of the National Institutes of Health should not be included under the jurisdiction of the science department. As you know, they have a rather extensive program of scholarships and grant-in-aid programs for basic research currently in operation. There is no doubt but what these programs are in the basic science area.

Another point that may justify strengthening is the lack of specifications for the position of Secretary of Science. It seems to me that some guidance in this direction might be taken from the language in the statute relating to the establishment of the National Science Foundation. I believe in this law; it is spelled out that the Director of the National Science Foundation must be a qualified scientist. If we are to establish a science department it seems only logical that the Director of such a large and important enterprise should be a person trained in science and not just an ordinary business administrator. I believe you would agree that such a position has as one of its very most important functions the guidance of attitude and policy toward science. My experience with the average run-of-the-mill administrators is that they are more concerned with mechanics of operation of the department and with the budget and with a whole host of other mechanical problems and not able to grasp the more subtle implications of policy and attitude toward the subject.

I hope you will give this subject everything you have as I honestly believe the survival of the free world may well depend upon the solution of this problem.

Sincerely,

W. G. KUBICEK, *Professor.*

APRIL 29, 1958.

Prof. W. G. KUBICEK,
The Medical School, University of Minnesota,
Minneapolis, Minn.

DEAR PROFESSOR KUBICEK: Senator Hubert H. Humphrey has forwarded copies of your letters of November 6, 1957, and January 30, 1958, commenting on the bill S. 3126, the Science and Technology Act of 1958, which was drafted by the staff of this committee. He asked that I communicate with your direct relative to the points you raise in your communications.

All the matters you outlined were considered in detail by the staff, and consultations were held with individual scientists and other officials both within and outside the Federal Government as to the proper presentation of a general legislative proposal covering the coordination of Federal science activities. Of necessity, some concrete proposals were required to be submitted, as directed by the chairman, based on what the staff considered to be the consensus of views and upon these recommendations it was felt should be considered by the committee and the Congress. As Senator Humphrey has repeatedly stated, and as is set forth in Senator McClellan's letter of transmittal in Senate document 90 (copy of which I have sent to you), as well as throughout the staff's presentation of suggested provisions, the various titles of the bill are merely staff proposals and have not been approved or acted upon by members of the committee.

Under point No. 1 of your letter of January 30, 1958, you state that no provision was included with reference to financial support or assistance to colleges and universities in establishing or expanding research and laboratory facilities or for grants-in-aid programs in support of basic science research. You will note that reference was made to educational or scholarship grants programs at page 51 of Senate document 90. It is pointed out that, although there was such a provision authorizing educational loans, specifically in the physical and biological sciences, and in mathematics and engineering, this was a matter that would probably be acted upon by the Senate Committee on Labor and Public Welfare. That committee has held extensive hearings on a number of bills dealing with these subjects, including a bill introduced by Senator Humphrey proposing scholarship grants on a much broader scale than is incorporated in S. 3126. The Committee on Labor and Public Welfare held hearings from January 21 through March 13, 1958, and the chief clerk of that committee, Mr. Stewart McClure, will be glad to send you the hearings if you desire a copy.

Under points Nos. 1 and 2, you comment on the research institutes proposed to be established for the advancement of fundamental science programs. You will note on page 45 of Senate Document 90 it is specifically stated that, in the view of

the staff, it is contemplated that these institutes would work closely with the scientific and technical departments of existing universities and schools of technology. It was anticipated that only in those areas where such educational institutions were unable to undertake the development and operation of advanced institutes in a particular area of science, would the Government undertake the establishment of separate science and research centers, such as in meterology, oceanography, and other fields where no single university or industry could provide the necessary funds or facilities. In this connection you indicate that, according to your interpretation of the language of the bill, the Secretary would be authorized to establish institutes or research centers to be administered only by private nonprofit institutions. I agree with you that if this interpretation is correct, the bill should be amended not only to eliminate any such a possibility but to insure that the facilities of colleges and universities shall be fully utilized. The objective is to provide a means of coordinating the contributions of the most talented scientists and instructors, not only in connection with the university activities but in the development of basic science programs operated under the supervision and direction of the universities with Federal financial support.

This is a complicated matter and, as you will note on pages 195–196, Prof. John H. William of the University of Minnesota has already taken issue with the staff's objectives. I can only say this proposal was presented in what the staff considered to be the most constructive manner possible and you will note from the Senate document, has wide support. The final determination as to whether or not such a program should be established and the premises upon which it will operate can only be determined by the appropriate committees after hearings and full evaluation of testimony presented for or against this phase of the bill.

Under the third point you indicate that, according to your interpretation, a student qualifying under the proposed educational loan program would be required to perform services directly for the Federal Government in order to qualify for the cancellation provisions. Again I assure you that the inclusion of the language "or employment on any project or program designated by the Secretary" (pp. 49–51) was intended to include such projects as may be approved by the Secretary on any Federal grant or aid program to universities or the institutes proposed to be created pursuant to provisions of the bill. If this intent is not entirely clear, the bill should be amended accordingly, should this title of the bill be approved by the Congress.

As regards the inclusion of the National Institutes of Health and other scientific programs of the Government, I refer you to page 12 of Senate Document 90 which sets forth the position of the staff in drafting the bill without providing the transfer of these programs to the proposed department. This is an area which requires policy determination by the Congress, as pointed out on pages 11–12 and 39–40. In other words, if all science activities were incorporated into a department, the structure would be too cumbersome for proper administration, and the objectives of the bill would be defeated, since there are 38 agencies of the Government now engaged in some type of scientific activity. It was the view of the staff that appropriate technical and professional consultants and staff should be made available to standing committees on science and technology which would then be able to give full consideration to all the problems involved and in a position to determine what components should be transferred to the new proposed department.

The staff is in complete agreement with your observations made on page 3 as to the necessity of strengthening the language of the bill in the form of a general declaration of policy and intent, as was pointed out in the proposed amendment 9 at page 57, and on page 19. This is specifically a matter of congressional policy, and it was the view of the staff that the Members of Congress themselves should develop such a declaration rather than that the staff attempt to do so.

The point you raised relative to the qualifications of the Secretary is one which has been outlined extensively throughout the Senate document. I refer specifically to pages 13 through 16. As has been pointed out, this same issue was raised by doctors and educators when the committee was considering the proposal to create a Department of Health, Education, and Welfare, who contended that the head of the Department must of necessity be a doctor of medicine or an educator. An official of the Atomic Energy Commission informed the staff that there were perhaps 50 scientists in administrative positions within that agency; that these officials were now administrators and not scientists; that they had not been able to keep abreast of basic science developments in nuclear energy; and that the proper flexibility in the appointment of qualified administrators and scientific consultants, the operation of the program would be much improved over what it is today. One of the purposes of the proposal to create research institutes was to provide either sabbatical leave for training or a rotation program for scientists

engaged in administrative work, in lieu of a suggestion that a National University be created for that purpose (p. 46).

In your letter of November 6, 1957, you commented relative to the basic science operations of the defense agencies. You will note on pages 11 and 12 of the Senate document that emphasis was placed on the need for evaluation of these activities and for a determination as to whether or not basic or fundamental science should be transferred to civilian agencies, with the military scientific and technological personnel free to devote all their time and effort to military application of scientific development. As you have pointed out, the difficulty in connection with the creation of a proposed National Aeronautics and Space Agency is that the Department of Defense controls all but a small percentage of funds made available for the development of science and research. That issue has already been raised in connection with the consideration of the President's program to create this new agency, and it has been pointed out if this proposal is adopted by the Congress, or S. 3126 is approved in some form, adequate funds should, if the program is to succeed, be made available to the civilian agency outside of military control.

Sincerely yours,

WALTER L. REYNOLDS, *Staff Director.*

UNIVERSITY OF MINNESOTA,
THE MEDICAL SCHOOL,
Minneapolis, January 29, 1958.

Senator HUBERT HUMPHREY,
Senate Office Building,
Washington, D. C.

DEAR HUBERT: I have your letter of January 24, and I think that I cannot make the Monday morning time that you suggest because the meeting that I am to attend will undoubtedly be settling the important issues for which I am going at just about that time. There is going to be something of a wrangle over policy with respect to the mechanism of United States participation in the International Union of Biological Sciences. The chairman of the group, Dr. Paul Weiss, of the Rockefeller Institute for Medical Research, is opposed to setting up some more democratic procedures for United States participation which I favor, and I want to be able to do battle with him that morning. However, I shall call your office about noon on Monday to see whether we could possibly have a few minutes together in the afternoon or whether you would be free for a few minutes Tuesday morning. In the latter case, I will stay over an extra day.

Just in case that you may not have time to see me, I should like to put down in writing a few of the points which I have in mind. Let me say that Bill Kubicek has shown me the draft by the Senate Committee on Government Operations of the bill to create a department of science and technology and so forth. This is Committee Print No. 2, January 17, 1958.

In general, I am in favor of such legislation. I would have preferred to see science and education rather than science and technology put together, but this may be impossible from a political viewpoint. I would call attention to the fact that you leave out a great deal of technology as well as science when you leave everything that is now in agriculture and in the Department of HEW out of the planning. I wonder, too, whether part of the HEW program, in particu lar that of the National Institutes of Health, should not be incorporated within the act. Anyhow, it would probably raise a great furor of a political nature to shift that part of the USPHS to another department, but I think it would make possible better coordination between the National Science Foundation and the National Institutes of Health with respect to support of research and training in the biological fields if both agencies were under one head.

A second point that I think is very important has to do with section 406 and provides that cancellation of loans may be made if the borrower accepts full-time employment in the Federal Government. It goes on with a very obscure authorization for the Secretary to designate any project or program in the science field. I think this is very unwise because a major reason for setting up a loan program would seem to me to be to increase our supply of high-school and college teachers. Certainly, there is no good reason why municipal, county, or State employment after graduation should not be considered to be just as much in the national interest as Federal employment. In fact, I think the existing emphasis would cause many people to oppose the entire program because it would constitute an automatic increase of $1,500 per annum for any person who goes to work for the

Federal Government as compared with what he would get if he worked in a comparable wage-rate position in any other situation. Actually, I think you are going to get in great trouble with private nonprofit institutions with this provision as it stands because they will see their competitive position gravely prejudiced by the present wording. Actually, it would hurt them very much because most private colleges must get a large share of their teaching personnel from recent graduates for economic reasons. I feel confident that you would be wise to change this before introducing the bill.

Another item that troubles me is the specific authorization in title 5, section 501, for the Secretary to establish programs outside the United States for such things as abstracting. I see no reason why this should not be authorized within the United States just as specifically, especially because we have major abstracting agencies which need help.

Another question that I have is in regard to section 302 under title 3. I am not at all sure that the setting up of a lot of huge institutes comparable to the Bethesda operation of the National Institutes of Health and the Naval Medical Research Center are in the public interest when they grow too large. We have already sequestered an enormous number of scientists from contact with teaching in these institutes. I am all in favor of having very high caliber people in them, but I do not like the idea of promoting their unlimited growth at the expense of the institutions of higher education where our production of scientists for the future must be carried on. There is an economic problem here as well as a sociological one. No one knows how many competent young people will want to work in the sciences in the future, and I would like to see us go slow in setting up new research institutes or enlarging existing ones until we know that we are going to have adequate staff both for them and for the universities.

I also note that nothing is said in the proposed bill about grants-in-aid to academic institutions for research and teaching. Perhaps you think that existing statutory authority for other programs is adequate by transfer. I raise the question as to whether it might not be desirable to put something into this bill which would cover the case nevertheless.

Much of what I have said, I suppose, is a reflection of my opinion that it is impossible to dissociate support of science and technology from support of education in those fields and support of research in educational institutions. This is again related to the philosophy of the department you propose to create. I predict that it will not work in the interests of the country if the only support to education is in the field of student loans. This is too small an item in the total picture.

With best personal regards, I am,

Sincerely yours,

MAURICE B. VISSCHER.

APRIL 29, 1958.

DR. MAURICE B. VISSCHER,
Department of Physiology, Medical School,
University of Minnesota, Minneapolis, Minn.

DEAR DR. VISSCHER: Senator Hubert H. Humphrey has referred your letter of January 29, 1958, in which you comment on the proposed Science and Technology Act of 1958, to the staff for consideration when the committee holds hearings on the bill. Senator Humphrey also requested that I give you more information on the specific points raised in your letter.

The question of proposing a Department of Science and Education was considered at length by the staff before the bill was prepared as a committee print. After discussing the matter with a number of scientists and officials of the Government, the staff took the view that this had been a matter which warranted further study by the committee due to various points that were advanced, an illustration of which is set forth in a letter from Dr. Wallace R. Brode on page 20 of Senate Document 90, which I have forwarded to you. In addition, the legislative history of the Department of Health, Education, and Welfare, which was considered over a period of 7 or 8 years by this committee (p. 13), and on the Science and Technology Act proposed in 1947, revealed that, unless additional information was available to indicate the need for emphasis being placed upon the educational aspects of the Federal science program, there would be little chance of having the Congress accept such a proposal. The immediate objective of the staff was to stress the necessity of developing a coordinated Federal program for the development of basic or fundamental science, from which would flow research programs in applied science and technology. Perhaps the one solution would be, if the Congress should approve the creation of a new department, to

designate it as a Department of Science, since there is general acceptance that its major activities would be in the basic sciences and that such activities cannot be separated from education.

In connection with your reference to the necessity of including the National Institutes of Health and the Agricultural Research Service within the new department, you will note that (p. 12 of S. Doc. 90) the reasons for omitting these activities are set forth very briefly. Also, on pages 39–40, it is pointed out that the proposed new Department merely includes those components which have governmentwide operations, and that, should Committees on Science and Technology be created, competent staffs including consultants in the various fields of science would be available to the new committees, who would be in a far better position to recommend appropriate transfers of science functions into or out of the new Department than would the staff of this committee. The final composition of such a Department would be determined by the Congress after full evaluation of all the science functions of the Government and their relationship to each other by competent, qualified staff consultants in the fields of science, including health and educational functions.

With reference to your comments concerning the proposed Institutes of Scientific Research, the staff would be the first to admit that the language contained in this title is not specific enough to cover all of its potentialities. An effort was made, however, to point up the fact that these institutes should work closely with the scientific and technical departments of existing universities and schools of technology (p. 45). It was further indicated that only in those instances, such as in meteorology, oceanography, etc., where universities (or industry) would be unable to undertake the creation and supervision of such an institute, would they be established outside of university control. It was also contemplated that, instead of depriving university faculties of skilled scientists and instructors, these institutes would provide them with expanded opportunities for advanced basic scientific research, and for developing qualified instructors through the use of the institute facilities in both basic and applied science. You will note that Dr. Jesse Shera has proposed the creation of a National Institute of Documentation as a part of this program in connection with the proposed hearings on the development of a center for documentation and communication research (p. 178), which are scheduled to begin on May 2, 1958.

The problem relating to loans versus grants in connection with the scholarship program is one which will probably be determined by other committees of the Congress. For instance, although Senator Humphrey introduced S. 3126, which would provide educational loans specifically for the education of students beyond the secondary school level, in the physical and biological sciences, mathematics and engineering, he also has sponsored legislation to provide for direct scholarship grants (p. 51), which was referred to the Senate Committee on Labor and Public Welfare. This latter committee held hearings on this and numerous other bills of similar import from January 21 through March 13, 1958. I am sure the clerk of that committee, Mr. Stewart E. McClure, will send you a copy of the hearings if you will write to him direct. In all probability, this committee will defer action on that title of the bill at least until the Committee on Labor and Public Welfare, which has a direct jurisdictional responsibility in this area, has acted. In drafting the proposed Science and Technology Act of 1958, the staff recognized that questions dealing with Federal aid to education and the support of scientific and educational institutions would come within the jurisdiction of the Committee on Labor and Public Welfare, and no attempt was made to include complete proposals of this nature in view of their wide ramifications and the numerous proposals dealing with this subject, which has been submitted to other committees.

As indicated by the enclosed release, hearings are to be held on the abstracting and documentation of scientific information beginning this week, with the objective of providing Federal support to existing private and industrial facilities operating in this field. I am sure that consideration will also be given to the implications of title IV of S. 3126 (title V of the recommended substitute, p. 72), which is directed primarily to the use of counterpart funds to supplement any program which may be established in this country. A bill incorporating the language of this title is also being considered by the Committee on Foreign Relations which has direct jurisdiction over such matters (pp. 52–55).

As a matter of information, the bill, S. 3126, has also been rereferred to the Special Committee on Space and Astronautics, of which Senator Lyndon B. Johnson of Texas is chairman, for its consideration and recommendations before this committee may act on titles I and II.

Sincerely yours,

WALTER L. REYNOLDS, *Chief Clerk.*

SCIENCE AND TECHNOLOGY ACT OF 1958

TUESDAY, MAY 6, 1958

UNITED STATES SENATE,
SUBCOMMITTEE ON REORGANIZATION OF THE
COMMITTEE ON GOVERNMENT OPERATIONS
Washington, D. C.

The subcommittee met, pursuant to adjournment, at 10 a. m., in room 212, Senate Office Building, Senator Hubert H. Humphrey (chairman of the subcommittee) presiding.

Present: Senators Humphrey, Thurmond, Lausche, and Martin of Iowa

Also present: Walter L. Reynolds, chief clerk and staff director, Ann M. Grickis, assistant chief clerk, and W. E. O'Brien, professional staff member.

Senator HUMPHREY. The subcommittee will be in order.

We are continuing our testimony on the provisions of S. 3126, relating to the proposed establishment of a program for the coordination of scientific and technical information.

The first witness this morning will be Mr. Merritt L. Kastens, assistant director, Stanford Research Institute, Menlo Park, Calif. Mr. Clark accompanies him.

Before you begin, I should like to introduce into the record certain documents and letters I have received.

I have a letter signed by Lynn J. Bartlett, president of Information for Industry, Inc. I ask that it be made a part of the record.

(The letter referred to is as follows:)

INFORMATION FOR INDUSTRY, INC.,
Washington, D. C., May 2, 1958.

Mr. WALTER L. REYNOLDS,
Chief Clerk and Staff Director, Senate Committee on Government Operations, Senate Office Building, Washington, D. C.

DEAR MR. REYNOLDS: After attending the hearings today I thought you might be interested in the attached material. Since January 1, 1955, we have been covering the field of United States chemical patents. Though the field of interest itself is narrow, we have been surprised at the use industry and Government is making of the technical information contained in patents.

Use is by—

Sales	Market research
Basic and applied research	Management
New product development	Patent departments
Commercial development	

Our only competition exists in the Patent Office in their machining of steroid compounds contained in United States chemical patents. In spite of the general acceptance of machine application we have continued to add new subscribers.

A Bureau of Technical Information under a Secretary of Science and Technology is, I believe, the only organization that could coordinate the handling of technical information. This group could coordinate and stimulate the handling of technical information by Government and industrial organizations and pre-

vent unnecessary duplication. This should also result in much quicker processing of technical information.

The seientific attaché of the U. S. S. R. stated that he did not believe the United States could furnish a list of all Russian technical documents available for public sale that had been transferred into English. I requested an exchange of this type of information because if that country furnished us a list of all the technical articles written in English that had been translated into Russian, we would not spend approximately 20 percent of our time in translating from English to Russian and back to English. The same, of course, would hold true for the Russian documents being translated from Russian to English and back into Russian. The reason for this request was that we had submitted a request to the Office of Technical Services to index all of the Russian translated technical information under control of the Department of Commerce.

The words "science" and 'technology," are often confusing because people imagine research directors making personal searches of technical information. The experience of Information for Industry, Inc., with both industrial and governmental research laboratories is that no one above the level of group leader makes their own technical information searches. Other experience has shown us that basic research people have a tendency to be more prejudiced in their views than applied research people. This is contrary to popular belief but is based upon our own personal experience.

I thought some of the above points might be of interest to you and your staff.

After reading S. 3126 and attending the hearing today I wish to compliment you and your staff upon handling a difficult text in a most efficient and unbiased manner.

Sincerely,

LYNN J. BARTLETT, *President.*

P. S.—At a later date we covered the United States electronics patents issued in 1955. By analyzing both electronics and chemical patents we disclose all patents dealing with atomic energy. This is along the lines of the point made by Mr. D. C. Hilty.

L. J. B.

Senator HUMPHREY. We also have a very fine letter from Eugene B. Jackson, librarian of the research staff of the General Motors Corp., Detroit, Mich., relating both to Senate Document No. 90, the staff study, and to the bill before us, the Science and Technology Act of 1958.

This letter is very helpful and makes several observations relating to the proposal before us that I believe members of the committee will want to study. I bring these letters to the attention of the committee and make them a part of the record.

(The letter referred to is as follows:)

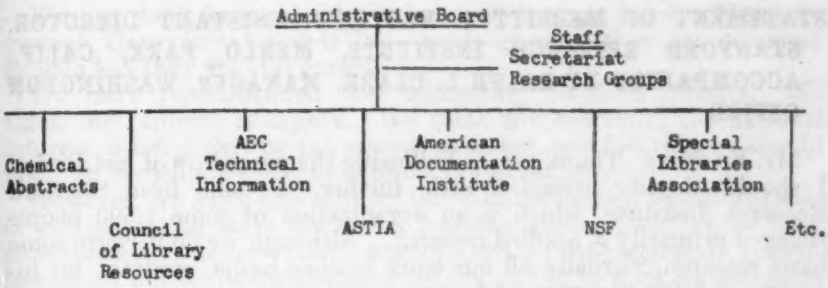
RESEARCH STAFF,
GENERAL MOTORS CORP.,
Detroit, Mich., May 1, 1958.

Hon. JOHN L. MCCLELLAN,
Chairman, Committee on Government Operations,
United States Senate, Washington, D. C.

DEAR SENATOR MCCLELLAN: Scientific information is an important part of the total problem of science and technology. I am, therefore, much encouraged to note that you are holding hearings on this subject in the next several days. Your kindness in sending me Senate Document No. 90, 85th Congress, 2d session, Analysis and Summary, prepared by your staff on the Science and Technology Act of 1958, is greatly appreciated.

The Western Reserve University's memorandum advocates a maximum use of existing information centers and services. I find myself in complete agreement with this particular point. A confederation of information centers might have many of the advantages of centralization without the disadvantages.

The confederation would (1) permit maximum utilization of existing facilities, staffs, and procedures; (2) cause least interference with present vested interests; (3) provide a small, flexible secretariat; (4) provide a research group of unlimited size (through detailing from member organizations); and (5) involve minimum of additional financial support. A possible organization chart is as follows:



The administrative board would be composed of one representative from each documentation service, professional organization, or foundation meeting the membership requirements set up by the administrative board. Qualifications could include size, subject scope, and type of material handled. By some device the administrative board membership should be equally divided among scientists, documentalists, and librarians. Major functions of the administrative board would be to decide on the community of interests, possibilities for procedural coordination, and division of subject responsibilities. The supposition here is that the areas of mutual coordination cooperation would materially increase with the passage of time.

This board would be assisted by a small staff for the secretariat functions and as large a staff as required for research purposes. Members of the confederation would be encouraged to detail qualified persons to the confederation research group so that crash programs on coding, terminology, programing, and the like could be carried out, as well as normal long-term research projects.

One encouraging factor in favor of the confederation approach is that at least one such group worked very well on a completely informal basis. This was the Group for Standardization of Information Services (GSIS) that coordinated the technical information efforts of Central Air Documents Office, AEC, Library of Congress' Navy Research Section, and NACA which flourished in the early 1950's. This group was able to divide subject fields, agree to discontinue announcing each other's reports, to exchange distribution lists, to establish the form for catalog cards, and to take steps toward merging of subject heading lists. Those participating in discussions were at the operating level but could commit their agencies on the matters under discussion and insure that agreements were put into practice without delay. The will to coordinate and cooperate was a main ingredient here in GSIS' life and this will could be regenerated on a newer and broader basis.

If you would care for further details on this informal confederation that did such superior work in documentation, several of the persons directly concerned are fortunately still in the Washington area. Among others I might mention: Dr. Mortimer Taube, then of the Atomic Energy Commission, now of Documentation, Inc., who is known to your committee for his memorandum of December 9, 1957, printed on pages 188–190 of Document No. 90; Mr. Bernard Fry, Deputy Director, Technical Information, Atomic Energy Commission; Dr. Dwight E. Gray, now of the National Science Foundation, then with Navy Research Section of ihe Library of Congress; E. Eugene Miller, now with Documentation, Inc., then of the NACA.

As one of the three United States Government-designated members of the Documentation Committee of the Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization, I would be most interested in receiving further materials as issued by your committee on S. 3126. Your findings on scientific information handling at the national level must necessarily have implications internationally as well.

Yours sincerely,

EUGENE B. JACKSON, *Librarian.*

Senator HUMPHREY. Mr. Kastens, we would like to hear from you.

STATEMENT OF MERRITT L. KASTENS, ASSISTANT DIRECTOR, STANFORD RESEARCH INSTITUTE, MENLO PARK, CALIF., ACCOMPANIED BY RALPH L. CLARK, MANAGER, WASHINGTON OFFICE

Mr. KASTENS. Thank you. Following the procedure of last Friday I should identify myself a little further. I come from Stanford Research Institute, which is an organization of some 1,500 people engaged primarily in applied research. Although we do perform some basic research, virtually all our work is done under contract for industry and for governmental agencies.

I emphasize the fact that we are in the business of using science and technology for a special reason which I think will be apparent in my testimony.

My own background is as a chemist, but currently my profession in a sense is as a research administrator, so that, like Mr. Hilty last week, my interest in this problem is largely in the administrative end of it.

I might remind you, too, that Stanford Research Institute is more or less on public record as to our thinking on this problem. You, I believe, received copies of our draft program earlier in the year. Perhaps just by referring to that position it will save us going over the entire thing again.

We have recommended that there be a central coordinating and planning agency set up under Federal Government auspices to handle this problem. We did not intend the monolythic operating structure referred to last week, of course, but one place where there was control, and particularly where there was planning of the overall situation.

Perhaps I might draw an analogy to the handling of other complex organization or system's problems in the national interest. When the Government decides that they want to build a Vanguard, they don't go and build a big plant across the Potomac and start to make all the parts. They use the capabilities that exist in the contract.

On the other hand, they don't simply get on the radio and say, "We think it would be nice to build a satellite, and anyone who has any ideas and would like to produce some part of the Vanguard—well, we encourage it."

Senator HUMPHREY. May we carry that analogy a little farther. What the Government does is to lay down a design or ask for a design and a program and then farms it out, so to speak, under central coordination, is that correct?

Mr. KASTENS. Exactly. And this is the point I want to make, that there is 1 plan, there is 1 system, but we try to put into gear all the existing capabilities the country possesses. This is, I think, one of the unique advantages of our kind of social organization, that we can call on so many capabilities and organizations in being. We feel that this approach should be used in meeting the technical information problem.

We have also said that before we tackle this problem it is important we know what the problem is. By implication we feel that we don't yet know exactly what the gross dimensions of the problem are. We don't know exactly how big it is, we don't know exactly its characteristics. And perhaps this is why there has been so much talk and so many conferences on this subject, and so little specific suggestion for action.

We just don't know how big a beast we have at hand. We make guesses, Government people have made guesses; they are educated guesses but they are still guesses.

We have recommended that something be done quickly. We think the problem is urgent. We think the economy, the national interest, is being hurt by the present situation, and feel that we should make an immediate effort to improve the situation.

However, we have also said we don't know enough equipmentwise or systemwise to solve the entire problem quickly, and so we have recommended what essentially amounts to a 2-phase approach; 1, to do something about the immediate problem, and 2, to work toward some kind of a solution that is more sophisticated and presumably more efficient that would serve the long-term interests of the country. We think this is going to require some new discoveries in equipment, in logic, and perhaps in our whole understanding of how we use technical information.

This all by way of preamble.

You have a copy of a statement before you. I will work from that. It is rather lengthy. I will probably skip some parts of it unless you have specific questions.

Senator HUMPHREY. We will include your statement in its totality as a part of your testimony, as well as the exhibit which you have presented to us, a Draft Program for the National Technical Information Center.

(The statement referred to is as follows:)

THE NATIONAL TECHNICAL INFORMATION PROBLEM

Gentlemen, in accepting your generous invitation to appear before this body to discuss the problem of the use of technical and scientific information in this country, I appear not in the role of a specialist on information processing, but rather as a representative of those who need and use such information in their daily work. More particularly, I will presume to speak for the some 275,000 scientists and engineers in the applied research and development laboratories of American industry and of the United States Government agencies, as well as an equal number of their professional colleagues in production, sales, market research, and executive functions who depend upon technical information for the fulfillment of their professional duties.

I would call your attention particularly to the fact that I am speaking of the applied research and development community and its related activities. It has been my observation that the smaller community, estimated at some 24,000 by the National Science Foundation, of basic scientists has been amply represented before this and other groups interested in the subject by a number of spokesmen in Government, notably those of the National Science Foundation, by speakers from some of the national professional societies and by prominent individuals.

It is not my intention to compare the relative worth of basic investigations versus the practical application of science and technology either on the basis of number of practitioners or any other basis. I do wish to call your attention to the nature and magnitude of the technical information needs of perhaps a half million highly trained scientists and engineers who for various reasons have not been effectively articulate on this and other questions of national science policy, and who have a large interest both professionally and economically in the technical information problem.

I might add that by implication I also speak for the managements in both industry and in the Government agencies, which must pay the bills for the present inadequate and cumbersome information processing facilities—a bill which SRI estimates presently exceeds $1 billion a year. Ultimately, of course, this cost must be borne by the United States economy as a whole. I submit, gentlemen, that the United States economy is not getting its money's worth for this expenditure. I submit further that a rational and adequate system for fulfilling this national function is unlikely to cost a great deal more, and may very well ulti-

mately cost a great deal less. The possible economic savings through the elimination of duplication of research and development effort and through the acceleration of the rate of technological progress which an adequate technical information system would make possible is extremely difficult to estimate quantitatively However, they undoubtedly are large.

A very recent survey of a group of industrial laboratories engaged primarily in contract work for the Department of Defense produced the estimate that 30 to 85 percent of the research and development effort unwittingly duplicated work already completed elsewhere because of the lack of effective channels of technical communication. This in spite of the fact that this same group of investigators was already spending nearly 10 percent of its time in seeking information from existing technical communications mediums. An experienced Government research administrator has stated that because of the difficulty of adequately searching the past record of science and technology for previous related work, it is no longer economic to attempt a literature search for any research problem in which the experimental cost will be less than $100,000. When smaller experimental programs are involved, it is cheaper to go into the laboratory and repeat the research. Most research administrators and most practical reseachers have come to approximately this same decision, although they probably have not determined a specific dollar cutoff point.

However, there are other cases in which there is no economic alternative to using the existing record of scientific and technological accomplishment. I know of at least one military research program in which more than $1 million was spent on the preliminary literature search before the experimental program could be outlined. I know of other military areas where budgets of several million dollars a year are dedicated to the continuing surveillance of limited areas of technology. Similar examples could be drawn from industry.

These examples, I would emphasize again, are from the field of applied research. Programed research work directed at the ultimate solution of specific military and civilian technological problems not only accounts for more than 90 percent of the scientific and engineering effort in the United States but it makes greater and more explicit demands on the technical information system. Applied research is always done against a specific or an implied deadline. Time is of the essence in this kind of work. It may mean money; it may mean increased military potential; it may mean enhanced commercial competitive position, but it is always important. Therefore, the applied researcher whether in industry or in the Government needs his information promptly. When operating decisions must be made based on technological factors, the data which may be of critical importance today may quite literally be useless a few months from now. It is readily understandable therefore that these kind of scientific specialists are extremely frustrated by retrieval systems, such as those offered by some existing abstract services which only permit location of needed information from 3 to 5 years after the experimental work has been completed and the results released for publication. It is small wonder that such applied research specialists spend so much of their time and of their organizations' money in traveling across the country or across the world to attend technical meetings to attempt to find out what is happening now. I know one west coast company which has budgeted as much as 10 percent of its total research budget to send members of its professional research staff to technical meetings in an attempt to insure that it had the latest technical information.

The basic investigator, usually found in the academic laboratory, is under no such time pressure. The ultimate value of his completed work is by definition independent of the time at which the discovery is made. Furthermore, action decisions are seldom made directly as a result of a theoretical discovery.

The applied research specialist uses a much broader spectrum of information sources than the basic research man. The academic investigator is free to define his own problem and his own goal. He tends to make this definition within the classical categories of science. Since the theoretical journals are in general obligingly organized along these same categories, the possible places where significant literature might appear are relatively few. The objectives set for the applied research men, unfortunately, do not come neatly packaged—as problems in chemistry, or biology, or solid-state physics, or even electrical engineering. He is asked to devise a nose cone for a missile, or a practical treatment for a specific disease, or a production unit to accomplish a particular process. He therefore can expect to find useful information in the publications of a dozen or more disciplines at levels ranging from the most theoretical to the trade literature and perhaps even advertisements.

By the same token, in an advanced area of basic theory there often are only a few dozen productive workers in the entire world. Such a group can, and usually does, maintain more or less direct communications. They are reasonably assured that no important discovery relating to their interests will arise very far outside of this circle. The specialist with a practical problem knows that he must call directly or indirectly on the talents and knowledge of a broad range of specialists for the information he needs. He must turn to the formal literature to seek the help of those outside of his own organization and his own circle of acquaintances.

Finally, applied research tends to be episodic. A problem is presented; a workable solution is attained; another problem is presented. The applied research specialist is presented at periodic intervals with the need to acquaint himself with a new body of knowledge related to, but different from, that which he has used in the past. The fundamental investigator tends to devote his professional career either to one specific area of investigation or to a closely connected and regularly evolving series of subjects which are naturally related one to another. He seldom is faced with the need to locate and digest a large body of new knowledge in which he had previously had relatively little interest.

I have emphasized in some detail these differences between the activities of the applied research and development community and the basic research community in order to indicate the differences in both size and nature of their respective information needs. I think this differentiation is particularly significant in that it does much to explain why certain Government agencies, notably the National Science Foundation, and some of the professional societies, and scientific information services have tended to appear complacent about the technical information problem. These organizations and their spokesmen either are part of, or are primarily influenced by, the academic scientist and engineer and the basic research specialist generally. Keeping in mind the relatively small size of the academic and basic research communities and, therefore, the relative simplicity of their information problems, and then, further, the nature of the need for and use of scientific information by this group, there may be strong justification for the statements by the groups' spokesmen that their problem is not large. They often seem to say, "Perhaps a little more money please, so that we can do a little more of what we are doing now; but for heaven's sakes, let's keep the Government out of the situation."

In marked contrast to this attitude is the sentiment which predominates in the industrial community and is strongly echoed by the technical agencies of the Defense Department. Here we find the belief that the cost of finding and using technological information is already oppressively large; that the present system for many practical purposes has already broken down; that the existing facilities are cumbersome, unreliable, and in some instances so thoroughly useless, that they must be duplicated again and again in individual laboratory organizations.

Both these positions can be justifiable. It may be that the basic scientific community does not have a serious technical information problem one that can be met by orderly improvement of the existing organizations and practices. It is certainly true that the much larger applied research community has a tremendous and critical problem in obtaining the scientific and technical information it needs and that this problem requires prompt, massive, and original action for its solution. I urge that this committee keep the distinction between these problems in mind in attempting to determine the proper role of the Federal Government in this field. Let me emphasize once more that these statements do not reflect any evaluation of the relative importance to our society of basic or applied research. They relate only to the characteristics of the technical information problem. They should by no means be interpreted to mean that the needs and interests of the basic research community should be ignored in this matter, nor do they imply that the proper solution to the information problems of the applied researcher would be of no use to the fundamental investigator. I believe that any system which would provide an adequate solution to the problems of the applied research community will automatically present considerable benefits to basic science and would almost certainly advance the rate of fundamental discovery.

If we agree that there is a real, national problem in processing technical information, what are the specific characteristics of the problem and what sort of mechanism is suitable for its solution? First of all, there is no question but that it is a large problem. Publishing, processing, and storing scientific and technical information is probably accounting for expenditures of about $1 billion a year. The users of the information must spend many additional millions of dollars to use this information. We have made some very rough estimates at Stanford Research Institute and believe that nearly 25 percent of our entire research budget is devoted to acquiring, processing, storing, and disseminating information. A

major part of this expense, of course, is in the time our professional staff spent in reading, searching the literature, attending seminars, etc. If our estimates are right and our experience is at all typical, then the various public and private organizations which during 1958 are expected to spend between nine and ten billion dollars on research and development activities will be paying between two and two and one-half billion dollars for the use of existing technical and scientific knowledge. There is considerable overlap between these two figures but it may very well be that we are dedicating more than one-half of 1 percent of our gross national product to this problem of technical information systems. I do not mean to imply that this amount of money is in any sense wasted or that a large percentage of it could be saved through the development and use of an ideally operating, highly efficient information processing system. I do submit that it is a tremendous expenditure for a service which is not statisfying the vast majority of its users. Furthermore, there is ample evidence of duplication and inefficiency to show that the efficiency of the present system could be markedly improved and even a small percentage increase could return an impressive number of dollars.

Now, as large as these numbers are at the present time, the most disconcerting aspect of the situation is that most of the factors involved are increasing exponentially, i. e., they do not simply add a regular increment every year, but rather increase by the multiplication of some factor so that each year the added amount is greater than the year before. Total research expenditures in the United States are increasing on a pretty steady trend line of about 10 percent per year. Obviously, the more research we do, the more information we organize, the more material there is to be published, processed, and searched through, the more chance there is of finding something useful.

Unfortunately, superimposed on this growth curve is an unfortunate characteristic of present information processing systems. Indexes and catalogs tend to grow at a faster rate than the information they provide a key to. The cost of maintaining the same quality of service in a library goes up faster than the number of books in the library. You can see this in your own experience—if you have a small library at home, you can find what you want with no system of organization. If your library is a little larger, perhaps you put in a crude system by shelving the books by subject or alphabetically. If you have a large personal library, you may need a simple card catalog, which will require the attention of a secretary or a clerk. Eventually you will need file cabinets, special desks, and all sorts of costly paraphernalia to make your library useful to you. Without having the figures, I would be willing to wager that the history of the budget of the Library of Congress would show some such exponental relationship between the size of the collection and the cost of servicing it. As a practical matter, however, libraries often allow the level of their service to deteriorate as they become larger rather than to support the oppressive additional cost of handling larger volume.

Finally, there is a factor in the growth pattern which is the most explosive of all and perhaps particularly significant especially in terms of the differentiation I have been emphasizing between the volume of research done in universities and that done in applied research laboratories. Just as there has been a marked trend during the past 25 years for the center of gravity of research efforts to move off the campus and into nonacademic laboratories, there has been an even sharper tendency for the center of research library work to follow this same route. In 1940 there were about 200 so-called special libraries, mostly private industrial libraries, in the United States. In 1953 there were over 2,500 such libraries. By 1955 there were nearly 4,000. Today there are undoubtedly over 5,000. The budgets of these special libraries vary widely, and it is extremely difficult to make a reasonable estimate of their total expenditures; but it is quite probable that their total expenditures now are approaching those of the combined university libraries of the country and their present trend line will take them well beyond the university library total within the next few years.

There is considerable difficulty in assessing the actual total size of the technical information problem, or, more pertinently, the probable size of the activity that would be required to pull the present services into a system. However, there is even less known about the qualitative nature of this problem. It is obvious that many kinds of people use technical information for a vast variety of purposes. They ask their questions in many forms. They need their answers in at least as great a diversity of forms. The relative importance, both quantitative and qualitative, of the various kinds of users and the relative needs for different kinds of answers is almost a wholly unexplored field. However, these questions must be understood and at least partially answered before an effective solution can be sought for the overall problem.

This lack of definitive information on the nature of the technical information problem has seriously hampered constructive thinking on the possible solution to the problem. The literature, including the testimony before this and several other legislative committees, records many opinions, guesses, ideas, speculations, and generalities. However, it is very difficult to come to grips with the problem or to consider the relative merits of various proposals put forward without having for comparison some ideas of the specific dimensions of the problem. As you know, Stanford Research Institute early this year recommended that the first operational step toward the solution of the problem must be a measuring, a survey, of just what has to be done, and what is being done. Subsequently, the Council for Documentation Research at a special meeting in February arrived at the same conclusion and petitioned the National Academy of Sciences to seek mechanisms to have such a survey made. The data from such a survey are even required to consider such questions of who should be responsible for the technical information system in the country, as well as what that system will be. Stanford Research Institute has stated that we believe this is a problem which requires coordination on a national level, and that the problem is of such magnitude and complexity that the planning and coordination function can only be accomplished by an instrument of the Federal Government. Now I am sure that we at SRI are no more inclined than other people who have considered this problem to impose a new responsibility on the Federal Government, nor are we anxious to introduce a new Federal agency into either our professional or our operational program if it can be avoided. We arrived at our conclusion, perhaps reluctantly, as a result of a crude estimate of the size and complexion of the national function involved. We believe that the matter is too big to be handled by voluntary cooperation between separate activities, independent development by commercial interests of propriety devices and procedures, or as a separate private enterprise, either commercial or nonprofit. It is significant that others who have suggested various nongovernmental organizational schemes have without exception assumed that the problem was substantially smaller and simpler than we have.

It should also be pointed out that even our most generous estimate of the magnitude of this problem does not approach the size of the billion dollar budgets involved in the development and implementation, for instance of some of the missile weapons systems problems of recent years. We are still talking here in the range well below the cost of the development of a nuclear submarine, or for that matter the planning and construction of a large hydroelectric installation.

A further direct implication of our estimate of the nature of the problem is our belief that a solution must be sought through a single, planned, integrated, program of development which attacks all of the complex facets of the problem as they occur in relation to the problem as a whole. The same line of reasoning leads us to expect that the ultimate solution will be found in a single, integrated system operating as a coordinated network of activities, rather than as a multitude of independent activities somehow or other combining to meet a single need.

Now I must admit that our approach to this problem has undoubtedly been affected substantially by our experience with large "systems" such as the national banking system and particularly, weapon systems developments. Without wishing to emphasize unduly the military implications of timely, comprehensive technical information and its relationship to the speed of development and production of military hardware, it is not unwarranted in our present technological era to consider the technical information capabilities of this country as, in its own way, a weapon system. It is perhaps even more pertinent to observe that both the conceptual and mechanical complexity of the technical information function taken in its entirety is paralleled only in some of the larger modern weapon systems. In developing and making operational these complex capabilities, it was discovered some years ago that fragmentary, "cooperative," independent development and planning of individual components was cripplingly inefficient and too often a complete failure. We submit that the technical information problem is of similar complexity and requires similar techniques. Our experience in the systems approach to complex problems leads us to have profound respect for the power and efficiency of these techniques. With these techniques at our disposal we feel confident that a problem can be attacked in its entirety and that a workable and economical solution can be found. With this confidence, we see no need to attack the problem piecemeal, with some blind faith that somehow or another it will all work together in the end. It is also probably this experience with complex systems problems that makes us impatient with those who have counseled extreme caution, procrastination, or despair when confronted with this problem in all its complexity.

I would like to make one closing remark in regard to cost, particularly operating cost. The objection is frequently raised that any centrally administered program, particularly one run by the Federal Government, would attain monstrous proportions and would be too costly. A further argument contends that the cost of a machine system for storage and retrieval of information would be excessive because of high capital investment and would "freeze out the little fellow."

I have tried to point out earlier that the present costs of information processing are indeed monstrous, and it would seem to me to be contrary to our entire principle of our American economy to contend that by centralizing and standardizing an operation, eliminating manual effort and duplication, that our overall costs would be increased. Why in this particular kind of operation there should be the contention that handcrafting and custom design of systems is less costly than what amounts to "mass production" is difficult for me to follow, but this argument is essentially presented. A more reasonable argument is that such a procedure would introduce some of the shortcomings of mass production—that the service would be less personalized, and less closely fitted to the specific needs of the user. This argument may very well be valid, but it too must ultimately be considered on economic grounds. We may then find that we will prefer a Chevrolet which will provide adequate transportation to a custom-made vehicle exactly adapted to each particular requirement or idiosyncrasy which costs ten times as much.

The second argument, I believe, is also based on lack of knowledge or understanding of the economics of the present situation. Remember now that I am talking here only about the area in which the knowledge of science and engineering is applied to the practical problems of the world. Thus, the university scholar is excepted from this discussion for the present. From this special point of view, the "little fellow" has been long since frozen out. Adequate searching of the technical literature for the solution of any kind of complex technological problem under the primitive conditions existing today requires special talents and facilities as well as an expenditure of money well beyond the resources of the "little fellow," whether he be a scholar, inventor, or a small-to-medium-sized-business man. Granting our "little man" has the appropriate technical competence, he must gain access to a special library. The public research libraries adapted to the needs of applied research men in this country can virtually be counted on the fingers of one hand. The university libraries do not generally serve this purpose. They function largely as a depository in which the information may very well be available but can be reasonably located only by literature specialists or individual scholars with the profound knowledge of the literature of their field. Larger organizations have their own libraries and staff them with special librarians and literature subject specialists in order to be able to locate and obtain the technical information they feel their organization needs. Such facilities and staffs are expensive. Companies which support them do not do it for prestige reasons, but because it is the only practical way for them to make use of the existing hodgepodge of literature services. The individual, or small organization, cannot afford such facilities. Even with facilities available labor and material costs for such a literature search of a problem of any complexity will run between $1,000 and $100,000. In exceptional cases such as the military one I mentioned earlier, they may run substantially more than that.

Gentlemen, the "little man" is out of this business already. His only hope lies in a generalized facility where he can pay only for his pro rata share of the use of the facility and not be forced to maintain an entire independent facility of his own—in an information processing system which will give the information he needs at less than the present prohibitive cost.

If we go beyond the simple economic considerations to questions of social equity, a single, central system would make it feasible to effect policies whereby certain groups may be subsidized in their use of the technical information. Certainly, special privileges could be extended to outstanding scholars. Perhaps workers in certain fields such as medical research could be granted cost advantages. If it were deemed to be in the national interest, special provisions could be made to serve small-business men at something less than actual cost. Under the present circumstances, such policies cannot be practically implemented. Some private information services do make their publications available at less than cost to universities and other selected groups. Many such services are subsidized through one medium or another by industry or even by government. But this is a hit-or-miss approach, which does not actually get to the major items of cost, nor does it permit very precise application to attain the greatest national good.

I thank you for your attention and will close by merely reminding you once more than we are dealing here with a problem which is already costing our economy

a great many millions of dollars. Its cost in duplication of effort, in the delay of technological development, and in its detrimental effect on progress toward greater public health, and other social objectives is incalculable. It is a situation that is presently critical and is becoming worse at an alarming rate. It is a problem which must some day be solved for the United States and ultimately must be faced on a worldwide basis. I commend you for your interest and wish you success in your efforts to assure that a positive and rational national program is initiated.

STANFORD RESEARCH INSTITUTE,
Menlo Park, Calif., January 1958.

A DRAFT PROGRAM FOR A NATIONAL TECHNICAL INFORMATION CENTER

THE PROBLEM

The preeminent position of the United States as a world power is dependent upon continued leadership in science and technology. Of vital importance to technical progress is the ready availability and applicability of discoveries, concepts, and data from all sources—past and present, foreign and domestic.

Existing mechanisms for processing technical information are unable to cope with the present deluge of publications. The result has been enormous duplication of effort and expense, serious delay of technological progress, and failure to realize the full potential of a rapidly expanding military and civilian research effort.

THE PROGRAM

This document describes a program to solve the Nation's technical information problem through the establishment of a national center for the collection, processing, storing, retrieval, and dissemination of scientific and technical information from both foreign and domestic sources. The program comprises the following actions:

1. Establish a central organizing and administering agency.
2. Determine the gross dimensions of the problem.
3. Establish an interim information center using existing services and techniques.
4. Analyze the factors which determine the design and operation of an ultimate National Technical Information Center.
5. Encourage present and initiate additional research and engineering development programs leading to systems and equipment necessary to implement the ultimate National Technical Information Center.

NATIONAL TECHNICAL INFORMATION CENTER

Because of the size and nature of the National Technical Information Center, it should be administered by a federally constituted agency.

It is strongly recommended that the resources and services of the center be equally accessible to all research, industrial, academic, and Government organizations throughout the country, consistent with security requirements.

In view of the breadth of service anticipated and the demonstrable economic value of these services, the center should be at least partially supported through service fees from its various users.

There is no inherent limitation on the scope of subject matter which can be processed by an operation such as described here. However, in order to develop an integrated system in a reasonable time, it is desirable to place arbitrary boundaries on the information to be included. At present the most highly organized and easily defined body of information is the literature of the physical and biological sciences. There are compelling practical incentives to include the slightly less well-organized literature of the various fields of engineering and medicine. It is recommended that the initial planning of the system be limited to not more than these categories. Once the center is in operation, a well-conceived system can be extended to encompass the literature of law, the behavioral sciences, and other fields of importance, but which are presently less easily organized for systematic processing. This expansion should be undertaken at the earliest possible time.

An inherent function of the central organizing and administering body is to establish a strong program of research. This research effort must probe into

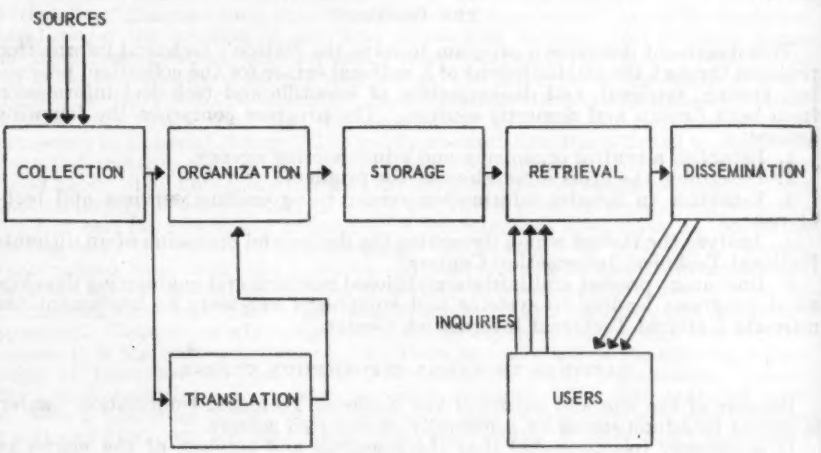
the origins, transmittal, and use of information. It must also develop the principles and mechanics of new devices for use by the center. It is not intended that the center itself conduct all or even a major part of such research and development programs, but rather that the agency contract for and coordinate such efforts wherever they can be carried out most effectively.

The center is expected to function as a coordinating and communications focus in its information processing operations rather than as a completely self-contained mechanism. Undoubtedly, a large volume of the operation will be conducted at a single location, but modern communication facilities make it unnecessary for the entire operation to be physically centralized. Furthermore, dispersed operation will permit exploitation of already existing capacities and thus make possible earlier and more economical operation.

The center in its interim form will utilize large numbers of specialized personnel employing manual techniques similar to those presently employed by large technical abstracting services, such as that of the American Chemical Society and the Soviet Technical Information Institute. However, as the system evolves and as mechanized equipment is developed and becomes available, the operation should become increasingly mechanized. With this evolution the service should become speedier, more comprehensive, and more creative.

INFORMATION FLOW

The functions of the National Technical Information Center, in both its initial manual form and its ultimate highly mechanized development, can be represented by the following flow diagram:



BACKGROUND

Man's most persistent medium for recording his progress and for communicating his ideas and discoveries to others is the written word. In the world of science this communication is formalized in periodicals, reports, and books. In recent years the rapidly growing volume of such publications threatens technical communications with a paralyzing glut and ultimate collapse. Inability to deal with the rising flood of technical publications has already seriously handicapped this country's industrial and scientific development.

Furthermore, increasing concern has been felt over the time for new products—particularly new military devices—to reach the manufacturing stage. History of any technical development from conception to the finished product shows that the major time interval lies between discovery of the basic principle and demonstration of its practical usefulness in the laboratory. This period may extend for decades. On the other hand, even the most involved development engineering seldom requires more than 5 or 10 years. More time is lost—or more time is to be gained—between idea and demonstration than between demonstration and production. It is in this period, where ideas rather than physical materials are involved, that speedup is most feasible. Information has no inertia; it can be accelerated infinitely—subject only to the limits of our skill and facilities for transmission and correlation.

Existing information handling processes and library services are based largely on techniques developed more than 50 years ago. Recent research and development efforts have produced fragments of solutions at best. The continued vitality of scientific progress in this country demands a generalized solution to the information problem. In an era in which scientific and technological accomplishment is the measure of a nation's international stature, the problem is of compelling urgency.

MAGNITUDE OF REQUIRED EFFORT

The magnitude of an undertaking designed to process a major part of the world's technical information cannot be measured by any single parameter. However, certain figures emphasize the massive nature of the required effort. Informed estimates provide the following data on the world's output of technical literature:

	Total	Annual growth, percent
Responsible technical journals	30,000 to 50,000	
Articles published annually	500,000 to 2,000,000	10 to 15.
Technical books published annually	60,000	
Documents issued annually (U. S. Government only)	100,000 to 150,000	30 to 40.

The heaviest users of technical literature in the country are the 200,000 professional research specialists who spend from 5 to 25 percent of their time seeking useful published information. The engineering profession makes much less use of such information by reason of its difficulty of access. The resulting duplication of development effort increases costs and injects unwarranted delays in product availability. Several thousand research libraries representing millions of dollars of annual operating costs and tens of millions of reference items utilize some 500 abstracting and indexing services in a valiant but futile effort to meet these informational needs. Coordination and integration of these services and operations would reduce the waste of money and scientific manpower.

In addition to struggling with the sheer volume of the literature, the American scientific community encounters an increasing complication in dealing with the technical information published in languages other than English. There is a serious lack of awareness in the United States of the growing significance of foreign technical publications. Limited data indicate that "pure" scientists refer to foreign sources (including those published in English) about 30 percent of the time; "applied" scientists 10 percent; and engineers even less. Apparently the information extracted from foreign language literature by United States scientists and engineers is very small, yet this literature as a whole is probably expanding much more rapidly than that in English. Furthermore, the number of languages in which technical information is being generated is increasing.

No complete information processing facility exists in this country or abroad. However, beginnings toward this objective have been made by the Soviet Union through the Soviet All-Union Institute of Scientific and Technical Information founded in 1952. Its function is to accumulate the published technical literature of the world, process it and distribute abstracts, reviews, and compendia as quickly as possible. The full-time staff of 2,300 specialists is supplemented by 20,000 scientists and engineers who serve as abstractors add translators on a part-time basis.[1] The relative effectiveness of this Institute is attested to by prominent American scientists who have said that the best way to determine what American science is doing is to read the Russian abstract literature.

Soviet scientists have undoubtedly found their Technical Information Institute an important factor in the scientific race with the West. Only a few months intervene between publication of western research information and when it is placed in the hands of a Soviet worker in his own language. Duplication of research and library effort is reduced, thereby permitting more effective use of the scarce and valuable trained manpower, and all investigators enjoy the stimulation resulting from access to the thinking of colleagues throughout the world.

The Soviet Institute does not appear to provide extensive facilities for systematic searching of the literature. It is known to have a strong and far-advanced research and development program aimed at creating mechanized search and re-

[1] An operation of this size in the United States would require an annual operating budget of about $60 million, excluding cost of journals and books; printing and distribution; and part-time abstractors and translators.

trieval devices. It is reported that the Soviet Institute has an operational English-Russian electronic translator. Furthermore, the Russian operation seems to limit its scope to the physical sciences, biology, and some branches of engineering; excluding medicine, law, economics, civil engineering, and other valuable areas of information. However, having developed the procedures to handle some categories of technical information, presumably the institute will ultimately extend its activities into additional subject fields.

METHOD OF APPROACH

The actions proposed below have two prime objectives, which must be pursued simultaneously. First, to meet the Nation's most immediate needs, it is considered necessary that an interim technical information center be brought into being as quickly as possible to collect, process, and disseminate technical information. Second, to establish, following analysis and research, an ultimate National Technical Information Center, utilizing maximum mechanization for accelerating the flow of technical information from all parts of the world into the laboratories of the United States.

The success of the program depends inherently upon the coordination and continuity of the five actions outlined below:

1. Establish a central organizing and administering Agency

An Agency of the United States should be established with the responsibility and authority to make arrangements for the conduct of research, development, and operations relating to the interim and ultimate National Technical Information Center. The Agency will employ directly a small staff consistent with its policymaking, contracting, and administrative functions.

An extensive and continuing systems analysis of the Nation's technical information problems and programs will provide the basis upon which the Agency will contract for new research and development projects. Privately supported research and development efforts will be encouraged when they are consistent with the Agency's long-range goals. Existing and new technical information projects conducted by other Government agencies will be subject to the review and concurrence of this Agency. In this way all aspects of the national technical information problem will be dealt with in an expeditious, systematic, and well-integrated manner.

Operation of the National Technical Information Center may be conducted under contract to the Agency. Such an operation will involve the coordinated participation of many supporting services, in conjunction with a central information processing and storage facility.

Program details would be formulated by the Agency as the requirements develop.

2. Determine the gross dimensions of the problem

Before any steps can be taken to establish even an interim technical information center, it will be necessary to achieve a quantitative appreciation of the size and detail of the work to be done and the service to be rendered. A survey to this end should be initiated promptly. The study would utilize known techniques and would provide reliable estimates of the magnitude of various factors critical to entering into the interim operation. Among these are the volume of technical publications produced in various subject categories; the distribution of technical information sources by country and language; the general nature, frequency, and number of user inquiries; the numbers and types of personnel required to staff an interim center; the size of facility and types of equipment required.

Many organizations have already recognized the importance of the information problem and have undertaken studies of several of these factors. (See appendix A.) These studies can contribute much valuable information for the design of the interim operation.

A large reservoir of facilities and experience in individual components of the information center's program is already in operation. Extensive but uncoordinated abstracting services exist. (See appendix B.) In addition, an estimated 500 to 700 industrial research groups maintain abstracting services in their own limited fields of interest. Translating services are less fully developed, but some are in operation and probably could be expanded. (See appendix C.) These and similar existing services will be inventoried and factored into the interim system to assure maximum economy and earliest possible operation.

These surveys can be completed in about 6 months if maximum practical concentration of effort is applied.

3. Establish an interim information center using existing services and techniques

The Nation need not await completion of extensive analyses or development programs before taking positive action to meet the immediate needs for better access to technical information. Immediate steps can be taken to establish an interim operation to perform at least part of the desired information processing functions using available techniques. The interim operation can provide at least translating, abstracting, and conventional indexing operations following procedures already developed by the major abstracting journals.

Unfortunately, the readily available techniques are largely manual. Fully developed machines are available only for small segments of the total operations. The available machines should be used in standard or modified form wherever possible. However, the interim operation will unavoidably require large numbers of specialized personnel. The supply of trained information specialists is small. Hence recruiting and training must be given careful thought in devising a plan for the immediate center if the plan is to be practicable.

The surveys outlined under action 2 will provide the basic parameters for the design of the interim center. Other studies of organization, operational analysis, machine feasibility, and short-term machine development programs will be undertaken as the interim center is brought into being.

The interim center will suffer from many inadequacies and inefficiencies, but an immediate partial solution to the Nation's information problem will have been provided. Better organization and dissemination of technical information will significantly reduce the volume of literature which the individual scientist or engineer must use. Our research and engineering laboratories will have improved access to the findings of colleagues in foreign lands, particularly those lands which are beginning to contribute important technical and scientific discoveries. Furthermore, existence of a center in operation will provide an insight into the systems problem that would be difficult, if not impossible, to gain completely through theoretical analysis.

Fortuitously, we are assured that this interim approach is feasible. The initial operation of the Soviet Technical Information Institute was undertaken on a similar basis—in fact, Russian spokesmen have said that it was a conscious extension of the methods of the American Chemical Abstracts. The Soviet Institute is in operation and seems to be effective. Its research program of the past 5 years is reportedly now beginning to produce unique advanced equipment for the refinement and extension of the Institute's services.

An aggresively and realistically pursued program in the United States could result in a similar operating center within 2 years.

4. Analyze the factors which determine the design and operation of an ultimate National Technical Information Center

There is a critical need to identify and evaluate the importance of the many factors pertinent to the design and operation of an ultimate National Technical Information Center. These include organizational and operational considerations. The organizational factor if particularly important for the encouragement of research necessary to implement successfully an ultimate information center, and it will be discussed separately later.

Human factors and machine factors constitute the two major operational considerations that must be systematically examined, and which will lead to a host of research problems. It is anticipated that systematic study of user needs and characteristics as well as research on the logic of information systems will have to be undertaken. Methods of classifying, abstracting, indexing, storing, retrieving, and disseminating increasingly formidable amounts of information will have to be studied in detail. No scheme for accomplishing these operations adequate to the needs of the scientific community is yet at hand.

It will be necessary to consider many machine factors and potential advances in the state of the art. No present machine is equal to the task of storing the immense quantities of information available. Even further from solution is the problem of achieving rapid access to a specific small fraction of a very large body of stored information. The complexity of the situation is further increased by the need for machine translation and organization. Partial solutions exist. Printed matter can be read by machines to a limited extent; machine translation from one language to another has been demonstrated on a small scale; high-speed handling of printed documents and turning of book pages are under development; high-speed printing mechanisms are now in operation. Major improvement in these machine capabilities is certain. When current machine performance is considered in the course of the system analysis, improvements will be identified which can be pursued in the research program.

Certain of the boundaries of the system analysis will be determined by policy decisions to be made by the governing agency. Who will pay for the service and on what basis? What kinds of information will be handled? Who will have access to the information?

The systems analysis will provide a basis for an objective design of an information retrieval structure that can meet the Nation's information needs with least time, money, and effort.

Experience gained from the interim technical information center will also contribute to the programing of specific research and development projects and to the design of the ultimate center.

5. Encourage present and initiate additional research and engineering development programs leading to systems and equipment necessary to implement an ultimate National Technical Information Center.

The Agency will guide the total research effort. It will encourage and support necessary research and development programs, prevent duplication of effort, and integrate and coordinate pertinent activities being undertaken throughout the country. It should have control over the rate of development of the center, primarily through its control of funding for research and development work.

This Agency will be responsible for aggressively thinking through and supporting an extensive and uninterrupted long-term research and development effort. The magnitude of this effort will determine the rate at which the ultimate center is designed and becomes operational. The Agency will be responsible for obtaining the services of individuals and laboratories possessing both capabilities and facilities for effectively contributing to the total program. Only through such an arrangement can an ultimate National Technical Information Center be established which will, in time, contribute markedly to the scientific and technical world leadership of this country.

BUDGETARY CONSIDERATIONS

This presentation provides only the broad outlines of a suggested program. Many refinements will have to be injected. Many details are ignored and many remain to be uncovered.

The intent here is primarily to indicate the magnitude of the program, something of the state of the art, and to suggest an approach to the solution of the compelling national need for better use of technical information. However, from these broad outlines and what is known about implementing programs of this size, order-of-magnitude estimates of immediate budget requirements can be made.

The compelling nature of the information problem suggests that funds be authorized immediately to pursue the initial investigation of the gross dimensions of the problem and to initiate the establishment of an interim center. Subsequent authorization of funds should also be sought to insure an agressive and continuing program. In addition, it may be assumed that private enterprise will continue to invest large sums in research and development, particularly on equipment necessary to mechanize information processes.

For the remainder of fiscal year 1958 a supplemental authorization of $2 million would meet the estimated needs of the governing body to support $500,000 for surveys and initial investigations, and $1.5 million to begin procurement of equipment and facilities to accommodate the interim technical information center.

It is too early to provide a definitive estimate for the fiscal year 1959 budget, but obligational authority should be sought for $50 million. Included in this figure are support of short-range research and engineering development necessary for the equipping and operation of the interim facility and for the beginning of the long-range systems analysis, initial staffing, and operation of the interim center. Support of certain long-range research and development programs of obvious pertinence to any system for the ultimate National Technical Information Center should be initiated during this period. It is questionable whether an optimum long-range research program could be attained within the figure given here, but a valid estimate is impossible at this time.

For the fiscal year 1960 and subsequent years the annual budget can be expected to exceed $100 million. The upper limit will be determined by the aggressiveness with which the research and development effort is pursued. It will also be affected by the extent to which the operation of the National Technical Information Center will be made self-supporting through charges for services. Such income can be substantial in view of the large present expenditures of Government and industrial organizations for individual services which may be relieved by the operation of the center.

CONCLUSION

The technical information needs of the Nation can be met by an intelligently conceived and earnestly pursued research, development, and operational program. Such a program will be difficult—it will be costly. However, it is neither more difficult nor more costly than other systems development programs which the United States has undertaken and completed to achieve and retain our internal and international status. The cost in lost prestige and technical stagnation which may result from failure to solve this problem might well prove catastrophic.

Stanford Research Institute has prepared the draft program for a National Technical Information Center as a public contribution to the solution of a national problem which it believes to be of critical importance.

The institute's experience in systems design, operations research, information organization, and in the conception and development of information processing devices, we believe, provides a unique perspective into the complex scope of this problem.

The institute maintains an active and expanding program of research in all phases of the information processing problem. The institute invites consideration for a role in planning and coordinating, as well as execution of appropriate research phases of any national technical information program, such as the one outlined herein.

A PARTIAL LIST OF ORGANIZATIONS CONDUCTING RESEARCH AND DEVELOPMENT IN INFORMATION PROCESSING

All-Union Institute of Scientific and Technical Information (U. S. S. R.)
Association of Special Libraries and Information Bureaux (England)
Battelle Memorial Institute
Birkbeck College (England)
Burroughs Corp.
California Institute of Technology
Cambridge Language Research Unit (England)
Case Institute of Technology
Chemical Abstracts Service
Columbia University
Documentation, Inc.
Dow Chemical Co.
Eastman Kodak Co.
Federal Telecommunications Laboratories
Eugene Garfield Associates
Georgetown University
Computation Laboratory of Harvard University
Herner, Meyer & Co.
International Business Machines Co.
International Telemeter Corp.
Lehigh University Library
Librascape
Arthur D. Little, Inc.
Low Temperature Research Station (England)
Magnavox Co.
Massachusetts Institute of Technology
National Academy of Sciences-National Research Council
National Bureau of Standards
National Cash Register Co.
North American Aviation, Inc.
Ramo-Wooldridge Corp.
RAND Corp.
Rutgers University
Sperry Rand Corp.
Stanford Research Institute
Teleregister Corp.
United States Patent Office
University of Michigan
University of Pennsylvania
University of Virginia
University of Washington
Western Reserve University
Zator Co.

A REPRESENTATIVE LIST OF PUBLIC AND COMMERCIAL TECHNICAL TRANSLATING SERVICES

American Institute of Biological Sciences, publishes four Russian biology journals in complete English translation
American Institute of Physics, publishes eight Russian physics journals in complete English translation
American Mathematical Society, publishes annual volumes of Russian mathematical papers
Associated Technical Services, a technical translating service providing material in 25 languages. Also issues periodic lists of articles translated in chemistry, physics, electronics, medicine, etc., predominantly Russian, but including many languages especially among Soviet countries
Berlitz Translation Service
Columbia Technical Translations, publishes physics series of the bulletin of the Academy of Sciences of the U. S. S. R.
Consultants Bureau, Inc., publishes 19 journals in the fields of chemistry, physics, electronics, geology, biology. Also issues translated tables of contents free and from time to time publishes collections of important papers on subjects of current interest
Engineering Societies Library
Far Eastern and Russian Institute
Henry Brutcher, technical translations, issues monthly list of translated articles available, with abstracts, from Russian, Polish, Japanese, German, and occasionally other languages
Institute of the Aeronautical Sciences
International Physical Index, Inc., translates, abstracts, and indexes over 60 leading Russian electronics and automation journals monthly. Complete bibliographic and translation services covering Russian language publications of the physical sciences also available
Morris D. Friedman, Russian translations, issues frequent lists of translated articles
Pergamon Institute, publishes an English translation of the Russian journal "Elektrichestvo," and translates three leading Russian journals in the fields of radio engineering, communications, and electronics. Also translates and publishes Russian books in English (Pergamon Press)
Primary sources, translates and publishes selected Russian technical papers from four Soviet journals dealing with research in metallurgy—to be published quarterly beginning with first issue (Quarterly Review) March 1958

Mr. KASTENS. To reemphasize the statements in the beginning: Because of the nature of our business and of my personal background, I am speaking only in terms of the applied research community, and the problems of its people. I am not speaking for, nor certainly not speaking against, the basic research people. But I believe there are essentially two different kinds of problems, problems of different magnitudes. One involves the needs of the applied research community, the people in industry and in Government laboratories who are solving problems, in a sense, producing practical results. The other involves researchers primarily in the universities, who are advancing knowledge, who are trying to find out more about our world, physical, biological, and so on.

I am not comparing these in any qualitative way. I merely say that I am speaking about what I understand, which is the applied research effort.

There are probably something like 10 times as many professional people working in the problem-solving kind of jobs than are working in the basic research effort. Again I am not saying that they are 10 times as important because there are 10 times as many. But they have a larger problem by the very nature of their size.

I quote here a recent study made by the Harvard Business School people and reported in the Harvard Business Review. It is a small study, it is a study of some Defense Department contract organiza-

tions in southern California which reported, among other things, an estimate that from 30 to 85 percent of the research and development effort in the organization surveyed unwittingly duplicates work already done elsewhere because of defective access to technical information.

Senator HUMPHREY. Because of defective facilities or lack of available information?

Mr. KASTENS. Because they didn't have the technical information. Some of this is caused by security restrictions, some of it is because of the awkwardness of the open literature. The range is large, 30 to 85 percent, but it is very difficult to make a close estimate of this kind of problem. But it does indicate that the problem is large; that there is substantial duplication of effort among Defense Department contractors; and I would guess in other sorts of applied research effort.

The same survey indicated that the professional people in these laboratories were already spending some 10 percent of their time trying to get the technical information from the literature. In spite of that 10 percent investment of time in information seeking, they still were duplicating, as they subsequently learned, some one-third to two-thirds of their time—wasting that time because the work had already been done elsewhere.

There is another result from an awareness of the extreme cost and difficulty of making an adequate literature search. There is a frequently quoted statement by a man who has had considerable experience in government research administration who said he has come to the conclusion that on any research project that costs less than $100,000 it doesn't pay to make a literature study at all. You may as well go right into the laboratory and start the work, because the chances of finding what you need, even if it is there, are so slim, and the cost of finding it is so great, that on a gambler's basis it is a better bet to go into the laboratories and do the work over.

However, sometimes you have no choice. Sometimes a problem is so big or so complex and you have so little notion of how you should go about it, you must go into the literature and at least try to find what has gone before.

This, if you have to do it on a big job and you want to do it thoroughly, is tremendously expensive. I know of at least one military research program where they spent over a million dollars searching the literature before they felt they could profitably go into the laboratories.

I know other government programs, primarily military, that have continuing efforts to search the literature, with annual budgets ranging from the many hundreds of thousands to the millions of dollars. This expenditure is made just to keep up with the literature of relatively narrow parts of the total technology, over and above the services provided by existing abstracters and publishers.

All the work of the existing services is not sufficient and so additional millions of dollars are being spent to try desperately to meet the problem.

These expenditures are made in connection with applied research efforts. I will repeatedly emphasize that point. However, 90 percent of our scientific and engineering efforts in the United States goes to applied research and development efforts; to the solving of specific problems. This, to me, seems to be the place where the real serious information problem lies.

The people in applied research are very much aware of this problem, both the managers and the active workers. They are frustrated. Many of them have almost abandoned the use of the literature for the simple reason that it is too hard—which means too costly or too time consuming—to deal with it. They go around to conferences and meetings in the hope that they can get some current information, because the information in the literature and that they can reach through the abstracting services is at least a year old, very often 5 or 6 or 7 or 8 years old before they can get at it, primarily through lack of adequate indexes.

There is one west coast company that I know of that allocates as much as 10 percent of its total research budget to send its people to meetings, just so they can find out what is going on now, what are the current advances in technology.

Timeliness is very much a major consideration with anyone who works in applied research. The basic man, in general, does not have that consideration. His work, by definition, is timeless. When he finds out an eternal truth about a phenomenon of nature, it is right and it is valuable today, tomorrow, and forever.

In some cases, if the applied man gets the information now, or makes the development today, it is extremely valuable in terms of national defense or commercial advantage or competitive position. If he gets the information or makes the development several months or a year from now it is completely worthless. This is a difference in kind in the situation facing the applied-research man and the basic-research man.

The applied research man also uses a broader spectrum of information. He gets his problems in practical terms. No one gives him a problem in chemistry, biology, or electrical engineering. He gets a problem to develop a nose cone for a missile, or to treat a certain disease, let's say. He may use the techniques of biology or chemistry or physics to solve these problems. But when he gets the problem it isn't stated that way and it is up to him to decide where he can go for appropriate information. And he may go any number of places. He goes to the theoretical journals, the trade literature, he may look in the advertisements in some of the engineering magazines. He doesn't know that it is in the Journal of Theoretical Physics that he will find his valuable information, whereas the man in theoretical physics knows that 80 or 90 percent of what he really wants to know will appear in a handful of journals. This is another difference in kind.

By the same token the basic research man usually knows almost everyone who is working in closely related fields. There is considerable personal, direct communication between these people. They keep current that way. The applied man never knows what sort of expertise he will have to call on to solve his problems. So he can't have a broad enough circle of acquaintances that he can go to directly for advice. He has to depend on formal literature.

I am emphasizing these differences because I think that there has been a confusion between these two problems, and this differentiation has not always been clearly brought out in some of the discussions of this subject in the past.

Some of the professional societies, and some of the scientific information services, and I feel many times that the National Science Foundation, have appeared to be somewhat complacent about the information problem. They say the problem isn't so big, it is nothing

to panic about, or do something about suddenly. But they, in general, are speaking about the problem of the basic research man, which may very well not be large or urgent; is perhaps not hurting the economy in its present state. If so they are perfectly right in taking that position. But I don't think it was always clear when they took that position that they were speaking of the problems of the basic research man, the academic man, as opposed to the large group of applied scientists and the research engineers. Or, for that matter, the development engineers and the operating engineers and the market research men and the executives, all of whom need this technical information in order to make the action decisions that they have to make every day, and they need it now, they need it quickly because they have to make a decision tomorrow. This is a need your basic man doesn't face.

Senator HUMPHREY. Some time ago Dr. Compton and Dr. Livingston, of MIT were down here to pay us a visit. A few of the Senators joined them for a luncheon. Each presented a paper. I recall that, on that occasion the general observation was to the effect that in the field of basic research we in the United States have a very substantial lead over our Soviet competitors, but it is in the field of applied research, particularly as it relates to the military where you have the need of application quickly to a concrete problem, where we have lagged. I think this is what you are directing your attention to.

Mr. KASTENS. Exactly.

Senator HUMPHREY. When you get into these specific problems where you seek a particular solution, that then the availability of the literature in the field and the printed knowledge becomes of paramount importance, particularly as to its timeliness. You are indicating here that in some of the instances the indexing is far behind?

Mr. KASTENS. That's right.

Senator HUMPHREY. The abstracting is far behind?

Mr. KASTENS. Yes, sir.

Senator HUMPHREY. So that even if you do receive a certain amount of literature it may have been outdated by subsequent literature which would bring you to a new position, if you could find it?

Mr. KASTENS. If you could find it.

Senator HUMPHREY. Therefore, by being unable to find it you may very well have repeated the research in this area which has already been done, already written up, described, and even abstracted, if you could find it.

Mr. KASTENS. And then taking it on the next step, someone may have made a decision to do something—put a product on the market, build a weapons system, some sort of a decision—based on this data that is 6 or 7 years old, not knowing that it has been nullified by something that has been learned, perhaps published, perhaps in a public journal, but he couldn't find it. And this is what is costly.

Senator HUMPHREY. Do you find people complaining to you about this very fact, people in the applied research areas?

Mr. KASTENS. Very definitely, the practitioners and the administrators. The man at the bench, as we sometimes say, in many cases—it is very disheartening—has given up trying to follow the literature. You start him on a project and you ask if he is going to make a literature search. "Gee whiz, it will take 6 months to make a

literature search. In 6 months I can do most of the research, and I don't know if I would find anything anyhow."

This probably isn't proper, in a sense isn't professional. These people are taught in school that the first thing you do on a research problem is make a literature search. But increasingly they are not doing it.

You go to industrial people, particularly the management-type people who I see the most of—like Mr. Hilty who was here last week—and you find almost a completely uniform position. In industry, or in the Defense Department laboratories, or among the Defense Department people who are responsible for the research and development programs you find in almost all cases the conviction—the frightened conviction—that the cost of finding and using information is oppressive, that it is so high as to be a very serious burden on their whole programs, and that the present system in many practical senses has broken down. It is not breaking down, it has broken down. This is in contrast to the feeling that, "Well, it is a problem but we have time." that you find among the people who circulate among the basic research community.

Senator HUMPHREY. And doesn't the constantly increased flow of literature that is being printed just get you further and further behind?

Mr. KASTENS. It gets worse and worse.

Senator HUMPHREY. It reminds me of my desk. [Laughter.]

Mr. KASTENS. I said to Mr. Reynolds, Friday, that this is an information retrieval device that we have here in these hearings, in a very real sense. Sometimes this is the only practical way that you can get information. It may be all written, all in the record, but nobody has time to read it or to find it.

The parallel is perhaps a very valid one to your own problem in getting the information that you need.

Senator HUMPHREY. If we work out any answers for you I hope they include some for me.

Mr. KASTENS. I am fully confident in saying that if you talk to anyone who is daily faced with the practical problems of running an applied research organization, you will find sentiments very similar to mine, namely, that the situation is chaotic, it is cumbersome, it is overly costly, and perhaps in extreme cases it is just inadequate, it is inoperative, it doesn't work.

I am not saying the basic people are less important than the applied or in any way making a value judgment about these two things. I am merely saying that they have two different kinds of problems.

If you will accept my contention that for the applied man there is a real problem, then the question essentially arises, How big a problem is this; what kind of a problem? I said we don't know a great deal about the size and nature of the problem, and that is true. But we can make some guesses about it. I would guess that the publishing, processing, and storing of scientific and technical information this year or today will cost the country about a billion dollars.

It will cost the general economy that eventually. Most of it actually is paid out by industry and government agencies in the forms of their operating budgets, their purchase of services and materials. But it is that much of a drain on our economy, in any case, no matter who is the instrument by which the payment is made.

Now, this cost only provides publishing, processing, storing. In order to use this information the people who use it, again primarily

industry and government, spend additional hundreds of millions of dollars.

At Stanford Research Institute we make a rough estimate that we spend some 25 percent of our entire research budget in acquiring, processing, storing, and disseminating information. A major part of this is in the time of our professional people, trying to get the stuff out of storage that we maintain for them. Some of it is spent in sending them to meetings or holding seminars of our own, trying to keep our people current.

If this estimate is anywhere near right—and our experience is at all typical of the entire applied research community —then the various public and private research organizations—that is, the Government labs, industrial labs, and so on—who are expected to spend between 9 and 10 billion dollars on research and development this year, will spend between 2 and 2½ billion dollars of that trying to get and use the technical information that has been recorded in the past.

There is an overlap between the first billion-dollar figure and the second 2 to 2½ billion-dollar figure. But what it amounts to is that we are probably, almost certainly, spending something like half a percent of our total gross national product in recording, storing, organizing, and using technical information. This is a big number. This is a big problem.

It isn't a waste. It isn't something we can go out and save by any act of magic. But the fact that it is such a big number means that even a 1 percent saving is also a large number. At least it is to us outside of government. I think it is even to government people.

Thomas Vaughn, former vice president for research of Colgate-Palmolive-Peet, has pointed out that for every 1 percent increase in efficiency of the professional people in industrial research—1 percent, an almost imperceptible increase in efficiency—you save about $25 million a year. I think we can save a lot more than 1 percent with a good technical information processing system.

In any case, if we are spending something like a half percent of our gross national product for this particular national function, it is an awful lot of money to spend on something which does not satisfy the needs of the majority of the users. If you were in a commercial situation selling a product under such circumstances you would never stay in business.

These are big numbers now, but they are getting bigger fast, and they are getting bigger exponentially, which is a fancy way of saying that you don't add a certain amount every year, but you add a certain percentage every year, so that the increment each year is larger than it was the year before. Research expenditures are going up at about 10 percent a year. They have been on that trend line for over 20 years It looks as if they are going to stay on it.

Every time you add to research expenditure you imply that you are going to produce more research results, which means that much more paper, reports, publications, that much more index, that much more abstract, and so on and so forth.

So the simple size of the problem is growing about 10 percent a year That means it doubles in somewhere between 7 and 10 years.

And still it is worse than that. At least in the present methods of library science, the cost of indexing or organizing literature goes up faster than the volume of literature. You double the number of books in a library and you more than double the size of the index and the

people that are required to maintain the indexes and so on, if you maintain the same quality of service.

There is another thing that is going on, too, which relates to my continuing emphasis on the differences in kind and location of research efforts. During the past 25 years the center of gravity of total research effort has definitely moved off the university campus. In perhaps a shorter period of time, but following that same trend, the center of research library work is moving off the university campus. It is moving into the so-called special libraries, which are primarily maintained by industry or by Government-operating organizations.

In 1940 there were about 200 so-called special libraries. In 1953 there were over 2,500. In 1955 there were over 4,000. Today there are certainly over 5,000. This is a very rapid trend line, and it seems to be a real one; it seems to be maintained.

These are libraries that are set up to serve the needs of practical people or people who have practical problems who need technical information to solve those problems.

Senator LAUSCHE. Might I ask you a question at this point? These 5,000 libraries, I assume, will continue in existence regardless of what the Federal Government does?

Mr. KASTENS. Almost certainly.

Senator LAUSCHE. If we do set up a coordinating or a stimulating agency of the Federal Government, can you now give your views, what you believe the operation would be? These 5,000, to begin with, would continue in existence. We would not take them over on the Federal basis. We would, however, establish some central agency that would plan, coordinate, stimulate, so as to simplify the method of obtaining information by those who need it; is that correct?

Mr. KASTENS. Yes, sir. These libraries would be the primary customers for any single information system. You remember on Friday, Mr. Mack, from Lehigh, said that as a librarian he was a customer of an information processing system. And these in a sense would be the large number of your primary customers. They would act as your purchasing agents, if you will, for their own organization and would probably be the avenue by which these organizations would use any single technical information system.

I don't think you will end up with the 300,000 scientists and engineers in industrial or applied research and development all directly using any central system. This would tend to be chaos. It would be very difficult to handle. It is fortunate that you have these specialists who can stand between the ultimate user and the information system. I would expect them to play that role.

Senator LAUSCHE. To what extent presently is there a coordinated exchange of information by these 5,000 libraries?

Mr. KASTENS. There is the interlibrary loan arrangement whereby they loan books to each other to fill out collections. That is, if one of our people, let's say, asks for a reference from the SRI library and the SRI library doesn't have it, immediately our librarians go to the union list to see who in the vicinity does have it. They fill out a special form that has been set up by the Special Libraries Association and send it to the other library to borrow the item. The other library sends it back and tells them the terms under which they can borrow it. This has been working well for some time.

However, there is so much increase in the traffic on the interlibrary loan system that we are in danger of having all our books ending up in the post office and none in the library.

Senator LAUSCHE. To what extent, if at all, have efforts been made without governmental intervention to achieve the things which you are suggesting the Government should undertake?

Mr. KASTENS. I don't know of any. Beyond these rather simple primitive sort of cooperative arrangements such as you have in interlibrary loan. The recently established Federation of Abstracting Services, with which you are familiar is just getting its charter. They have some hopes of rationalizing the overlap between the many abstracting services in this country. They certainly should be able to make some progress in that direction.

Senator MARTIN. The plan that you are suggesting will not disturb the further development of the number of private libraries at all?

Mr. KASTENS. I would not expect it to.

Senator MARTIN. Nor their general style of functioning?

Mr. KASTENS. It will, only in their peripheral activities. Many of these special libraries have substantial budgets to prepare their own abstract journals. There are a tremendous number of abstract publication prepared within companies to meet the companies' own needs. Some of these are quite elaborate, come out every week, and they run a number of pages. This is effort the company feels it must make because the commercial or society abstracts are much too slow or not adequately done. The company must spend this money in order to have adequate access to information. It is duplicated, triplicated, quadruplicated, all over the country. If there is an adequate system this sort of activities could be done away with.

Senator MARTIN. This system then would cut down a great lot of the cost to the private industries in maintaining their present system?

Mr. KASTENS. I would think so, yes. Many companies have developed elaborate retrieving systems of their own. Some work has been done within companies to solve their own immediate problems. It hasn't been cheap. But it is a good investment because it ultimately saves considerable research cost.

Senator MARTIN. Your principal objective isn't so much to cut down the cost of it as it is to make it more efficient. Is that right?

Mr. KASTENS. Yes, and perhaps slow down the increase in the cost, which right now is going up at a kind of a frightening rate. There should be some saving. There should be some increase in efficiency.

Senator HUMPHREY. What do you think such a central system should do first? There ought to be some priorities. What do you envisage as a central system? What is it? We use the term, but what do you mean by it?

Mr. KASTENS. Speaking in broad generalities, because as I say we don't have very specific knowledge on what you can do, or what you can do most quickly, or what is most valuable. I think the thing you would probably strive for first, would be a central organization of the accessible technical information, the stuff that is already published. To get it indexed and organized in some way so that the man that needs it can find it quickly.

Senator HUMPHREY. Stop there. Would you have that done by a Government agency on what we call a line job, where you hire people in the Government, or would you contract this kind of thing out

through a Government coordinating body to private groups, to universities, and to specialized firms that could do the indexing and abstracting?

Mr. KASTENS. Guessing again, I would think you would probably end up doing both. You would contract out those components that you can find the capability for, where there is an organization in being or an organization that could be expanded to take on any part of this job. Certainly this would be the quickest way to get it into operation, to find out what people could do, where they were, and how much they could do, and then organize the whole problem into pieces that you could put out. There probably would be a central function left which would somehow have to be operated. There is no reason why that central function couldn't be farmed out too. This is a matter of Government organization which is not my particular specialty. I would certainly guess that you could find subassembly manufacturers, if you will, in large numbers, to do various parts of this job.

Senator HUMPHREY. Is what you seek a sort of a central index system? Let's say, an industrial firm in California to set out on a particular line of endeavor would like to make a literature check relating to this problem. They could call a library associated with this central agency and say, "Look, here is problem X; we want to get a literature check on all of this." Immediately that library, through these machines with all the lights, can check back through a chain of command, so to speak, and be able to come up in a short period of time with all the literature references on that particular subject. Is this what you seek?

Mr. KASTENS. Guessing again, but I suspect this would be the practical way, to retrieve the references, rather than the primary literature.

Senator HUMPHREY. Of course. That is what I am talking about.

Mr. KASTENS. There are plenty of repositories of literature, plenty of book warehouses that we call libraries, scattered all over the country.

Senator HUMPHREY. I think this is one of the real problems. We have these book libraries, these warehouses, spread all over the country. But who knows what is in them?

Mr. KASTENS. Exactly.

Senator HUMPHREY. Isn't this what you are trying to get at?

Mr. KASTENS. This is a little bit off on the side, but it is impressive to me. The librarian in the University of Illinois one time said there were 3 million volumes in his library that he couldn't locate, that were lost in the library.

Senator MARTIN. Could that be settled by remote control?

Mr. KASTENS. No. That probably could not. This was simply an operating problem within the library. But there are hundreds of thousands of articles of literature in the world technical literature that can't be found for a different reason, because they are just not organized anywhere where anybody can find them. It is almost a chance proposition of somebody happening to pick up the right magazine at the right time.

Senator HUMPHREY. Frankly, they are just not indexed.

Mr. KASTENS. They are not. Indexing is a simple word for it. It is a very complex thing to do but if you have to put it in one sentence—they are not properly indexed on a general, over-the-scientific-world basis.

Senator HUMPHREY. I suppose one of the most complicated jobs in anybody's operation is a filing system.

Mr. KASTENS. Yes.

Senator HUMPHREY. There are more good firms that break down and more good offices that break down over filing systems than any other one thing. You can have almost anybody run a place if you have a good file clerk.

Senator LAUSCHE. May I ask a question, Mr. Chairman?

Senator HUMPHREY. Yes; please.

Senator LAUSCHE. As I view this, there are three possibilities. One, the Federal Government entering into it merely to act as a catalytic agent and as a planner and director and allowing private enterprise to handle it.

No. 2 would be for the Federal Government to establish its own offices in which it would engage in operations of indexing, cataloging, and so forth.

No. 3, the Federal Government farming it out, but in substance still being the operator.

Now then, what about this No. 1 proposition with the Federal Government being the catalytic agent, planning, and stimulating and prodding and hoping that the job may be done by these 5,000 libraries collaborating and coordinating their activities and in some way setting up their own indexing and cataloging?

Mr. KASTENS. Speaking as a practical administrator, I don't believe it can happen. I don't think it will work. This is an opinion. I don't think there is any other way to answer this except as an opinion.

Senator LAUSCHE. Now, go to Nos. 2 and 3. Which is your choice?

Mr. KASTENS. I think it would be uneconomic; I think it would be stupidly wasteful for the Government to go and set up a tremendous operation to do this. Let's be frank. Let's talk about the Soviet system. The Soviets have had this central system for 7 years, roughly. We are 7 years behind.

I don't think we will ever catch up with them by copying what they did. I don't think we want to. I think we have to use the special power, the vitality that this country has, which is the existence of all these centers of initiative and all this predeveloped capability and weld this into a common productive system, to meet a national problem.

In exactly the same way we are doing with the airways safety problem, this is a national problem that everybody decided had to be handled. Government didn't set up a big radar and electronics laboratory and start doing research to solve the airways safety problem. They set up a commission and they tried to find out what everybody in the country was doing, to get everybody using their capabilities and intelligence and their planning ability and administrative ability on this national problem. But under one planning leadership.

I think this is the most efficient, the most appropriate way to tackle a large complex national problem.

Senator LAUSCHE. To what extent have these 5,000 libraries set up an efficient indexing and cataloging system, if you are able to answer that?

Mr. KASTENS. It is almost fair to say that there are 5,000 libraries and 5,000 systems.

Senator LAUSCHE. Has there been any exchange of indexes and catalogs?

Mr. KASTENS. Only to the extent that they are coordinated to some degree through the Library of Congress and the decimal system, and the basic practices of all libraries. There is a coordination in that sense.

Senator MARTIN. The information that you have given us here is extremely valuable in giving us a picture of the situation as it now stands. I am groping for an idea of what this central clearinghouse will look like, whether it is a thing in being physically, or whether it is more or less a coordination of farflung examinations of different libraries to find out what they have and then coordinate it in a sort of master index of some kind, and only direct inquiries to where it can be found.

You say you don't want a massive duplication here of the whole library, but you do want an idea of what is out there. Is that right?

Mr. KASTENS. Yes, sir.

Senator MARTIN. And would you picture this clearinghouse effort of the Government as more or less a flying squadron approach, to visit these places and determine if possible all that there is available there in these 5,000 libraries, and then bring this information together in a sort of a clearinghouse of reference to the place they can be found?

Mr. KASTENS. Let me try another analogy. I don't want to answer your question directly, in other words. I would suggest a network kind of configuration. Let's compare it to the telephone system. Where is the center of the telephone system? I don't know. But I do know I can go over there and pick up that telephone and I can call Timbuktu or I can call my office or I can call the President's office. It is all one system.

It is that kind of concept that I have in mind. So I don't know where the center would be, or exactly what the center would be. But I do know what I want to effectuate in this total system. I want to be able to pick up the phone, so to speak, in my library, and find out if anyone has ever written anything down about a present problem of mine.

Senator HUMPHREY. I think that your analogy is an excellent one, and it may be very well that the people in the telephone system might be able to help us.

That is not farfetched at all. This is an excellent analogy. Without having one big telephone book with all the numbers in the world in it, you can literally call every place in the world through a system which has been worked out and which is an operating system that no one person necessarily knows, but there is a chain of command and a line of contact and a sequence which leads one to the point that you wish to get. I think it is an excellent analogy.

Mr. REYNOLDS. We have Mr. Baker of the Bell Telephone Laboratories as a witness tomorrow. Maybe he can give you some information.

Senator HUMPHREY. I am sure he will be able to.

Mr. KASTENS. It is certainly no accident that it was in the telephone company technical organizations where the systems concept was primarily developed, and it was in the telephone company laboratories that the information theory techniques were developed by Dr. Shannon. They are used to facing just the kind of problems we are talking about here.

Senator HUMPHREY. May I say that you posed a problem here which I think is characteristic of our whole contest with the Soviet system. To philosophize for a moment, on the one hand is the highly disciplined, centralized system—a bureaucracy of the Soviets with its commissars and its whole apparatus from a central point. And they are able to bring to bear a tremendous force on any one selected objective, because it is all under one command.

Under our system, which is decentralized, scattered, dispersed, but in aggregate sum total of all of our dispersed items—and all of our decentralized factories, bureaus, groups, agencies, whatever they might be—is far greater, in power, in weight, in whatever descriptive terminology you would use, than the Soviets. But ours is a loose arrangement spread all over the lot.

Their's is concentrated power. For example, I never thought I would live to see the day when the Soviet Union produced more steel than we did, but last week it did. It produced more steel than the United States of America. And what is more, out of the steel that it produced it put a whole lot more into hardware on weapons than we do, even when producing at full capacity. So when we say to ourselves that they are ahead of us, they are only ahead of us because they are gearing up what engineering they have to a specific objective. We are behind in some of these areas simply because we have decided to use 2 percent of our capacity for defense, while they have decided to use 80 percent of their total capacity. Our total capacity may be 200 times greater than theirs, or a 100 times, or twice as great, but it is dispersed.

What you are talking about, even in this area of information coordination, is that we undoubtedly have more documents, more information, more technical literature, God only knows where—in somebody's basement, warehouse and in libraries. If you could ever get it all together once, and get somebody to work out an adequate system, we would have much more to draw from than they would. But the present situation is that the Senate had 7 to 8 years of operation under a central system. Whether that system will hold up under the tremendous weight of it or not is questionable. But at least up to now it has worked.

We have here a hundred years of a scattered system. It is like trying to find Lincoln's papers. We have no system for the protection of Presidential papers. We find some of them in somebody's woodshed. This is in a broader context. What you are trying to do is to bring to bear some kind of system that will tap this tremendous reservoir of power which is information.

Mr. KASTENS. And the reservoir of power which is the operations in being, the abstracting operations, the indexing, the organizing functions in general.

In addition to this material resource of the books scattered around, we have talent scattered around which is perhaps even a greater resource. I am sure we have more people who understand information processing, librarians, if you will, information specialists, than the Russians have. But they have them all concentrated, or let's say devoting their time to the problem in support of each other. Our people in general are working separately. I think if we want to do this thing most efficiently, we have to use these resources that we have, both the material and human resources.

Senator HUMPHREY. It is a kind of inventory control in a sense, only on a much greater dimension. That is the difference between going broke and making money.

Mr. KASTENS. Yes, sir.

Mr. CLARK. Mr. Chairman, I wonder if I can add one comment to your description of the Soviet system. As you know, they are now in process of decentralizing this to a considerable extent, because they find——

Senator HUMPHREY. It got too big?

Mr. CLARK. Yes, sir. The big monolithic system became too big. Now they are breaking the economy down and decentralizing it to the republics.

In the telephone system we have a central system and satellite systems geared to it. But you decentralize both authority and responsibility and therefore initiative and freedom to work within a general framework.

Senator HUMPHREY. This is valuable testimony. It overwhelms a person to think of the problem. Thank goodness people like the telephone company have worked on these things.

Mr. KASTENS. To go on with this statement a little bit, it doesn't overwhelm us. There is another use of the word system. System has a sort of jargon meaning, too, in addition to the one people generally use. Systems analysis, systems management, systems development refer to a body of technique, a body of technique as I indicated that had its beginnings in the Bell organization. It had been used primarily in military systems but not entirely, in weapons developments.

It is a way to attack just such a complex problem as the one we are discussing here. And this problem, if you compare it with the complexity of producing a satellite or the complexity of producing and supporting all the things that go with a modern weapons missile system, is not so overwhelming, it is not so large. It is not so large either in dollar numbers or in number of components or number of considerations, that must be taken into account.

And we do have some skill—when I say "we," I mean the United States—we do have some skills that are applicable to this kind of problem. We have solved these systems kinds of problems by a systems approach. And so we are not overwhelmed. We have considerable confidence in these systems techniques.

We think that this is a difficult problem, it is a large problem, it is a costly problem, but it is not an overwhelming problem.

On the other hand, the agencies responsible for weapons system, development learned some time ago that fragmentary, so-called cooperative independent development and planning where everybody worked on components and some poor airframe manufacturer tried to stick all these components into an airframe, didn't work.

You had to look at a weapons system capability as a system and develop the whole thing at the same time.

There are other examples: The airways modernization problem I mentioned; the national banking system that we have been working on at SRI. All have some similar characteristics.

We think that the technical information problem can be tackled, as a system, as one overall problem. We are not overhwelmed by the size or complexity, and I don't think we have to be. I think further

that if we can tackle it as a whole we should not tackle it piecemeal with a blind faith that it will come out all right in the end somehow.

I think perhaps it is familiarity with these systems techniques and the confidence from having used these techniques and used them successfully that sometimes makes us a little impatient with those who have counseled extreme caution or procrastination or out and out despair when they looked at this problem in its entirety.

I would like to make one more point that has to do with costs, not so much that it follows what I have said before but because it deals with some objections that are frequently raised in terms of operating cost. People say, "You don't want to have a single system run by the Government; it will cost too much. It will get so big that it will be too costly."

If you analyze that kind of objection I think it comes apart. As I have pointed out, the costs already are large. We are talking in the billions of dollars of expenditure of national assets now each year. So to be monstrous in comparison to the present costs it would have to be very large indeed. But it also seems to me somewhat contrary to our whole industrial philosophy to say that by standardizing an operation, centralizing it, coordinating it, eliminating manual effort, you will make the cost greater.

It is essentially saying that this is a peculiar kind of a thing in which handcrafting and custom designing are less costly than mass production. I don't think that argument can be supported, but it is usually not presented in detail. Too often, it is merely "Well, if the Government does it it will cost too much."

There is another argument that really goes along with this, that I think also is based on a lack of knowledge or understanding of the economics of the situation. It is essentially this: If we invest a lot of capital in a big machine system the "little man" will not be able to afford to use it. You freeze out the little man. Only the big organizations would be able to use such a system.

Remember, I am talking about applied work. I am not talking about the university people. If you leave them out of our considerations for the minute, the "little man" is already out. He has been frozen out a long time ago. He can't afford to use the present costly, cumbersome system we have today.

I don't care whether he is an inventor or small company——

Senator LAUSCHE. Let me stop you. He can't use the present costly system that we have today. That is, let's assume that he wants information from a certain library. Does that entail a cost to get?

Mr. KASTENS. It does in a sense. The number of public research libraries in this country you can just about count on your hand. I can count all that I know on one hand. The university libraries are in general available to the public, or you can make arrangements to get in, but they operate more as warehouses. If you know the literature completely, and you have all the time in the world, you can find it.

But the university library in general does not serve the man with a practical problem unless he is very knowledgeable about the literature himself.

Senator LAUSCHE. Is there any library anywhere to which you can write and say, "I want your assembled information on this subject" and for a price get that information?

Mr. KASTENS. Not that I know of, to any comprehensive degree.

Senator LAUSCHE. The excessive cost which the little fellow has to bear, is that entailed through making his own research effort in getting the information?

Mr. KASTENS. Yes. In all the complexity that that implies. The big company has a special library. The medium-sized company has one. They are working down until even the pretty small companies have them. Because they have to have them. They are not spending their money for these libraries for prestige or window trimming. It is the only way they can effectively get at technical information.

And if you don't have your own special library and your own special librarians, your own specialists in the use of information, you are essentially frozen out. Even when you have the library, the present cumbersome procedures mean that if you have anything but the most simple direct question, your literature search will cost you from $1,000 to $100,000, sometimes more as I indicated earlier, just for time and materials, to make the search.

This is a sizable amount of money, and the little fellow very often can't afford to compete in that scale with the organizations that already have their own setup going, and have the special librarians and subject specialists and access, through their library associations to books in all the other special libraries and so on.

But you, Senator Lausche, as far as that goes, if you would try to make a technical literature search starting tomorrow, it would take you a long time, and it would cost you a lot of money—and probably more than you would be willing to spend unless you were an extreme gambler. So that the little man is out. The only hope of providing service to the so-called little man is in first of all in a generalized facility, where he only has to pay his pro rata share of the capital cost. He doesn't have to wait until he can afford to set up a whole special library operation of his own.

Further than that, we have to find a cheaper way to get at this research literature before he can afford it anyhow.

If you want to go beyond the straight-out economic facts and speak in terms of social equity there is still another consideration. If you had a single system, then it becomes feasible, to essentially subsidize certain groups in their use of the technical information. You certainly would want to extend special privileges to outstanding scholars, perhaps workers in certain fields like medical research which could be given some kind of special consideration.

If for various reasons it was deemed desirable, you could make a cut-rate arrangement for small business by whatever definition you use for small business.

Under the present circumstances you can't do that no matter how much you want to, or how desirable it would be. There is no way to implement such a policy. Some of the information services, it is true, they provide their services on some kind of sliding ability-to-pay basis. But this involves a small part of the total costs of information use. It doesn't strike at the big items of cost. These are well-meaning efforts but they don't really solve the problem.

I did want to make these two somewhat peripheral points because they seem to be questions that arise frequently.

Beyond that, I would merely remind you again that we are dealing here with a problem which is already costing our economy many,

many millions of dollars, many hundreds of millions of dollars. This is the direct cost, the out-of-pocket cost. The cost in duplication of effort and in the delay of technological development and in deterring our progress toward greater public health and other social objectives, is at least as large.

Furthermore, the situation being presently critical is becoming worse at a very alarming rate. It is a problem that we must solve some day in the United States and in the world as a whole. We can't avoid it indefinitely. It can only get more costly as we delay.

I am very heartened by your interest in this problem and I certainly wish you success in your efforts to initiate a positive and rational program to meet the problem.

Senator HUMPHREY. Thank you very much, Mr. Kastens.

Senator LAUSCHE. I would like to ask another question.

Senator HUMPHREY. Go right ahead.

Senator LAUSCHE. On page 6 of your paper you point out that, in your opinion, between nine and ten billion dollars will be spent in 1958 in research.

Mr. KASTENS. Yes, sir.

Senator LAUSCHE. On the basis of that expenditure what part of it, in your opinion, is wasted through the failure to have some central office out of which information could be gotten through indexes and catalogs?

Mr. KASTENS. Well, using the Harvard figures just for a starter——

Senator LAUSCHE. That is what I had in mind.

Mr. KASTENS. Taking their low figure—if 30 percent of that money is wasted because it is spent to do something which has already been done—we are dealing with something like $3 billion worth of duplication, I don't presume that we could ever have an ideal system so that there would be no duplication, but at least we are shooting at a target of a $3 billion potential saving. If we get halfway there, if we get a system that in a sense is twice as good as we have now but not perfect, we are talking about a billion and a half dollars.

Senator LAUSCHE. On the same page the statement is made:

> We have made some very rough estimates at Stanford Research Institute and believe that nearly 25 percent of our entire research budget is devoted to acquiring, processing, storing, and disseminating information.

Does that 25 percent have a relationship to what you are saying was the test made at Harvard of 30 percent?

Mr. KASTENS. No.

Senator LAUSCHE. You differentiate between the two?

Mr. KASTENS. Those are different. It merely refers to our own analysis of our $15 million a year, total budget. What do we spend it for? We spend so much for libraries, so much for documentation center; we spend so much for sending our people to meetings; so much of our people's time is spent in seminars; we spend so much in writing reports and editing reports.

When you add it up it looks like about 25 percent of our total expenditure.

Senator LAUSCHE. And the other 75 percent is expended directly in doing the applied research work.

Mr. KASTENS. Unfortunately not, you see, because then you have other service activities. You have accounting department, purchasing department, and people like myself who don't produce anything.

So actually when you get down to the amount of effort that is actually spent creating at the bench, it is down to the order of 25 percent. I have heard the figure of 15 percent.

Senator LAUSCHE. I am an industrialist and I have some problem confronting me. I can engage Stanford to do research for me on that?

Mr. KASTENS. Yes, sir.

Senator LAUSCHE. And that is done on a compensatory basis in a way?

Mr. KASTENS. It is essentially a cost-plus-fee basis.

Senator LAUSCHE. And that covers all of the work which you do: research, bibliographies and so forth?

Mr. KASTENS. Yes, it must. You see we have no endowment.

Senator LAUSCHE. So that private enterprise at present is prepared to pay for services rendered?

Mr. KASTENS. They certainly are.

Senator LAUSCHE. And they do so?

Mr. KASTENS. They certainly do.

Senator LAUSCHE. In Columbus we have the Battelle Institute which does substantial work of that type. Ohio State University does some, is that correct?

Mr. KASTENS. That is correct.

Senator LAUSCHE. I suppose the Case School of Applied Science does.

Mr. KASTENS. The comparison with Battelle is most direct. There are slight differences in other cases but we are almost identical in operation to Battelle.

Senator LAUSCHE. Are you of the belief that the Federal Government, if it does provide this concentrated assembly of information, could in some measure try to recoup from those whom it provides with this information its expenditures?

Mr. KASTENS. I certainly think it should, and I would see no difficulty in it. This is not a matter of seeking any contribution or support in the sense of gift from industry. This is strictly a matter of paying for a service for which they are already paying very heavily, and of which they appreciate the value.

Senator LAUSCHE. The probability is that it would cost them much less if we had it systematized, if I may use that word, that it costs them now?

Mr. KASTENS. It certainly should. There is something wrong with the development if it doesn't.

Senator LAUSCHE. Thank you very much.

Senator HUMPHREY. Senator Martin?

Senator MARTIN. I think that Mr. Kastens has given us some very valuable information here. I do not wish to ask any further questions. I am still groping to see if we can get this proposed plan in shape to present to the Congress. I hope Congress hasn't the same nebulous ideas that I have right now.

Mr. KASTENS. I am afraid I can't answer your questions directly. If I knew exactly how to solve this, and what to do in the way of setting up an operation tomorrow, the chances are a lot of other people would know it and they would have known it long ago, and it probably would have been done. What I know is that there is a problem. I have confidence that the problem can be handled, that it is economic to handle it in terms of the general economy, and we should get about it. But I don't have any formula solution.

Senator LAUSCHE. Could we logically support a program to make an approach to the problem without purporting to have the whole system in mind before we start?

Mr. KASTENS. We have suggested in this draft program that the first thing you have to do is decide who is in charge, as Senator Humphrey said.

The second thing is to find out what the problem is. That is, measure it. I am not talking about psychoanalysis or trying to find out what scientists ought to do or how they ought to think. I would like to go out and find out how big this is, where it has the bumps on it and what shape it is.

Senator LAUSCHE. Wouldn't that be a pretty good objective at the outset, to do just that, to set up an investigating or study or analysis group to bring us back some suggestions?

Mr. KASTENS. I certainly do think this is the way to start. SRI has already gone on the record as saying we think that is the way to start. I think it would be kept clearly in mind that we are suggesting a measurement of the outside of the problem. If you just start studying, you can study until you are blue in the face and we all have long beards. But you have to have some kind of notion of how big this is and what its shape is, who uses it, what is your input and output. These are things you can measure.

Senator HUMPHREY. You suggested in your proposal of January 1958 on page 9—

> To establish a central organizing and administering agency. An agency of the United States should be established with responsibility and authority to make arrangement for the conduct of research, development, and operations relating to the interim and ultimate National Technical Service Center.

So you recommend that initial step, whether it is an agency or commission or an interim body, some kind of a start to evaluate the dimensions of the problem, to make the research or contract out the preliminary research that may be necessary to really make a fundamental approach.

Mr. KASTENS. Exactly.

Senator HUMPHREY. We have included this draft as a part of the record. I note in particular on pages 9–13 of your testimony, 5 or 6 positive suggestions that have been made on the basis of your own Stanford Research Institute, is that correct?

Mr. KASTENS. That is correct.

Senator MARTIN. And this draft program of the National Technical Information Center, contains essentially your recommendations, your own recommendations at this time?

Mr. KASTENS. That is right.

Senator HUMPHREY. Mr. Clark, do you have anything that you would like to contribute to this discussion?

Mr. CLARK. No, sir.

Senator HUMPHREY. What is your role, Mr. Clark?

Mr. CLARK. I am the manager of the Washington office.

Senator HUMPHREY. Of the Stanford Research Institute?

Mr. CLARK. Yes, sir.

Senator HUMPHREY. May I ask this question, Mr. Kastens, with reference to the draft proposal that you have given to us: Is this the composite thinking of a number of people in your institute?

Mr. KASTENS. Yes, sir. This draft program is the result of a study group that was formed almost 2 years ago and was formalized last fall and eventually produced this document.

Senator HUMPHREY. In other words, it would be, as Senator Lausche said a while ago, as if the Government had come to you and said, "We have a problem here throughout the Nation on the matter of technical and scientific information, we don't know quite what to do about it, would you make a study?" That is what you have really done without being directly asked?

Mr. KASTENS. Essentially that is it.

Senator HUMPHREY. You have voluntarily and on your own initiative come forth with a proposal. Our staff did get in touch with you last fall in connection with our study and the proposal involved in the bill. This is a result of your own initiative plus the extra request that was made through the staff, is that correct?

Mr. KASTENS. No, sir; this was prepared before we heard from your staff.

Senator HUMPHREY. We are very grateful to you.

Mr. CLARK. It is the sort of thing that people like ourselves and Battelle and Armour do once in a while when we see a big national problem. We set up our own project.

Senator LAUSCHE. Were you a participant in the meeting set up at Western Reserve University?

Mr. KASTENS. Yes, sir.

Senator LAUSCHE. Do part of the thoughts which you expressed today have some relationship to the discussions which were had by those agencies in attendance?

Mr. KASTENS. Yes. I certainly was struck in that program with the fact that the two representatives from industry who spoke at that time were again the ones that expressed the greatest urgency, the greatest sense of a real, immediate, critical problem.

Senator LAUSCHE. That is all that I have.

Senator HUMPHREY. Thank you very much.

Senator Thurmond, do you have any questions that you would like to ask?

Senator THURMOND. I don't believe I have any now.

Senator HUMPHREY. Thank you very much, Mr. Kastens. We are grateful to you and your organization for your helpfulness.

(Documents placed in the record by direction of the chairman are as follows:)

STANFORD RESEARCH INSTITUTE,
Menlo Park, Calif., May 16, 1958.

Hon. HUBERT M. HUMPHREY,
United States Senate,
Committee on Government Operations,
Washington, D. C.

MY DEAR SENATOR HUMPHREY: Let me say once more that I enjoyed tremendously the opportunity to appear before the Subcommittee on Reorganization last week. I know from subsequent conversations that all of the witnesses join me in a very favorable impression of the sincere interest of you and your colleagues in what to us is a very important problem.

A new issue of the SRI Journal has just appeared. Without wishing to confuse the matter further, but merely to emphasize once more the immense complexity of the information problem, I would like to call your attention to the article by Bourne and Engelbart beginning on page 2 entitled "Facets of the Technical Information Problem." You will find there some six pages of questions extracted from a much longer list which the people here at Stanford Research Institute

have compiled, and which we feel must be answered before we can attempt an operational solution to the problem.

If we can be of any further assistance to you, please do not hesitate to ask for our services.

Sincerely yours,

MERRITT L. KASTENS, *Assistant Director.*

[From the Journal, Stanford Research Institute, 1958, vol. 2, No. 1]

FACETS OF THE TECHNICAL INFORMATION PROBLEM [1]

Charles P. Bourne and Douglas C. Engelbart

[Technology, so adept in solving problems of man and his environment, must be directed to solving a Gargantuan problem of its own creation. A mass of technical information has been accumulated and at a rate that has far outstripped means for making it available to those working in science and engineering. But first the many concepts that must be considered in fashioning such a system and the needs to be served by it must be appraised. The complexities surrounding any approach to an integrated technical information system are suggested by the questions given here]

Recent world events have catapulted the problem of the presently unmanageable mass of technical information from one that should be solved to one that must be solved. The question is receiving serious and thoughtful consideration in many places in government, industry, and in the scientific and technical community.

One of the most obvious characteristics of the situation is its complexity. A solution to the problem must serve a diversity of users ranging from academic scientists engaged in fundamental investigations to industrial and governmental executives faced with management decisions that must be based on technical considerations. The solution must accommodate an almost overwhelming quantity of technical and scientific information publicly available in many forms through many kinds of media and in many languages.

Some students of the problem, including men with many years' experience in various aspects of information handling, have viewed this complexity and concluded that the problem cannot be solved in its entirety. These authorities have recommended a piecemeal attack on components of the problem.

Stanford Research Institute believes that the techniques of systems analysis coupled with an understanding of the potentials of machines permit a powerful approach to the solution of this many-faceted problem. In fact, it may very well be that only by grappling with the problem as a single, integrated system can a realistic and lasting solution be attained.

However, to deal with the information system as a whole, it is necessary first to define its complexities with as great detail as possible. As an aid to the preliminary mapping of the system, a study group at SRI polled a portion of the institute's own professional staff of engineers and scientists for questions they believe must be answered before an effective system can be designed. A representative list of the questions raised in this fashion is given in this article.

The list is impressive, but obviously not exhaustive. It does confirm the multiplicity of points of view that must be appreciated before this problem can be attacked.

Many of the questions require simple factual answers (see Data Needed About Information Sources and Services, p. 160). They can be answered by straightforward techniques of counting, surveying, sampling, and estimating. A few of the answers are already available, but the fact that most questions of this type cannot be answered from available sources emphasizes the pressing need for a much better quantitative assessment of the size and nature of the information problem before a rational attempt to solve it can be undertaken.

Another group of questions involves essentially matters of national and scientific policy that ultimately must be answered arbitrarily. Data and analysis can give guidance to the answers, but the ultimate decision will be based on judgment of relative needs and relative values.

[1] This copyrighted article is reprinted by permission of Stanford Research Institute, Menlo Park, Calif.

QUESTIONS RELATING TO POLICY

What are the specific aims of the program?

Will the system start with only new information? Or will it process back literature, and, if so, how far back?

Will the service process requests from Allied countries? To what extent? Will it coordinate with the Soviet Union?

Can part of the operations be done abroad? What about translation?

Will an international classification, indexing, or retrieval system be adopted or promoted?

Will the system be designed to serve the brilliant, the sophisticated, as well as the more unsophisticated?

Will the service be financially self-supporting?

Will big business have any better access than small businesses or individuals?

Would a private citizen or scholar afford to use the service?

How will prices be established for the service?

What is the range of subject matter to be included?

Will classified information be included?

Will safeguards be established to insure that classified information is kept under proper control?

What type of information should be included? Books (texts, tables)? Technical and trade journals? Conference proceedings and papers presented but not published? Industrial and Government interim and final project reports, etc.? Operation and instruction manuals? Patents? Manufacturers' catalogs? Newspapers and general magazines?

Who will be responsible for selecting the material to be included?

What protection will be provided users who want their queries to remain confidential?

Should service be provided outside the technical community? To Congressmen? Executives? Businessmen? High-school students?

Who will control the policy in the matter of designing, establishing, and/or operating the service? An appointed committee, such as for the NACA? A civil servant? A political appointee? A committee elected by scientific organizations?

Would it be feasible to establish legal authority to speed up the standardization and coordination of existing facilities (such as the FCC)?

Who is competent to design, establish, and/or operate the system? Would this be a civil-service organization?

Could the objectives of the service be achieved by expanding existing Government agencies (e. g., Bureau of Standards, the Library of Congress, Armed Services Technical Information Agency)?

If the service were not directed by some existing Government agency, would it not be best handled by some university?

Would it be economically feasible for any sort of commercial enterprise or nonprofit corporation organized by the professional community, or by private industry, to establish and run a service which would assure continued social and technical progress?

If we must look to the Federal Government for support, what residual responsibilities remain with the professional societies? Should private groups continue to sponsor special collections?

What economic and political limiting factors exist with respect to the freedom one would have in utilizing or changing those organizations already active in the documentation field, and whose existence could be overshadowed by a national service?

What about copyrights? Would royalties be forthcoming to the owner of the copyright if the service distributes the material? What will be the impact on the technical publishing industry?

Should the service act as a publisher for collections of papers (reprints) in very new and special fields?

How will the priority schedules be fixed for the service?

How soon could the service be initiated? With an immediate manual system? With an ultimate mechanized system?

What factors will determine the location? Can strategic dispersal considerations influence the location without adversely affecting efficiency?

Is the proposed service simply an attempt to copy Russia?

Might not an interim solution be to translate and distribute the exhaustive Russian abstracts, thus leaving our interim energies free for other uses?

Might it not be better to reduce the amount of literature produced rather than go to the tremendous expense of providing superservice for all of it? Can a quality filter be applied to this output?

Why not allocate Federal money to support more direct interchange between working scientists? Perhaps more meetings, special conventions, seminars, etc., would be more economical than better literature processing? Couldn't the money be better spent on education to achieve a given increase in scientific effectiveness?

Could a substantial portion of the information problem be solved by teaching the users more about present-day documentation techniques?

QUESTIONS REQUIRING RESEARCH

Some of the questions posed to the study group will require considerable study and research to produce valid answers. The research will be in many fields—in the social as well as in the natural sciences. Some of the study must be quite profound—even theoretical. Some will be more straightforward. Many of these questions must be answered before the policy decisions implied in the previous group can be made with confidence.

Can we separate apparent need, influenced by present concepts and experience, from real need? Lack of awareness of the potentialities of recently developed methods (or methods not yet developed) can easily result in an unimaginative formulation of the possibilities and opportunities for advantageously using recorded information.

How will users' habits and needs evolve as a good system becomes available?

How are the information needs of a user affected by his age, educational level, profession, type of position held, etc.?

What are the characteristic information needs of the basic (academic) scientist? The applied researcher? The engineer? The decision maker? Are they all equally critical, or is the applier of knowledge the one with the biggest problem?

What is the role of information retrieval, storage, etc., in the decision-making process of the research worker, engineer, scholar, administrator, etc.?

How much use does the scientist and engineer make of the facilities that are presently available?

By what processes does the scientist and engineer keep abreast of the advances in the art now? What are the relative importances of each of these processes?

How many scientists and engineers have a definite program of keeping up with the literature? How much time would they like to spend? What keeps them from spending more time?

How much of the literature that would, with reasonably high probability, be useful to a scientist or engineer, is caught by him now by his own regular surveillance of the literature? How far out of his way will the average user go to be sure that he hasn't missed some possible information—considering the usual distracting pressures on him, his familiarity with the sources, etc.?

How many pages of literature in various categories relative to the level and interest-area of the user can we expect him to scan or search for his different information needs?

What are the relative merits of the different types of reference information services with regard to the user and his needs, desires, habits, and limitations?

What are the relative importances of the users' various informational needs? On one hand, he needs to know the newsy items such as who is working on what, what his current attack is, who disagrees with whom and basically why, etc.; and on the other hand, he also needs to be able to study in detail the carefully written treatises that may have bearing on his work. Can these different kinds of needs be met by a single system?

What are the special information requirements for different specialty fields?

Does the user, when he goes outside his special field for supporting information, want information in different form or different levels than which he seeks in his own field? For instance, would he be looking more for cookbook techniques or for survey-type information?

How valuable would broad, multidisciplinary searches be if they could be conducted effectively? How great is the problem of differences in nomenclature between fields?

What type of questions now go unanswered at the libraries?

Isn't the main problem of information retrieval one of identification—since people so seldom express satisfactorily their needs to the documentalist?

What are the major limitations in the various methods presently used in classifying and indexing scientific literature?

Is the problem that the information now is just not available at all, or is it that it is just hard to find?

Why aren't the existing services that process technical information satisfactory?

How many places does a user of each discipline have to look for index listings of a given special interest?

How can the processing of recorded information be planned so that it can be effective in spite of human limitations, or of limitations in numbers of human beings?

How much is missed by technical people leaning too heavily on librarians?

What relative gain in efficiency could be achieved by integration, merging, or better managing of existing documentation services?

What increase in efficiency of the scientist or engineer would result from improving the accessibility of recorded information?

What are the probable net benefits, short and long range, of an effective information service to military, industrial, commercial, scholarly, government groups?

Can dollar costs be derived for reasonably well-proven delays and duplications, and can the total national loss rate due to this problem be realistically estimated? Can it be determined that the expense of delay and duplication now is greater than that of establishing and operating an information service?

What is the lack of an information service costing Government agencies?

Can the savings in Federal money now spent on other information programs be diverted to a national information service?

What are the relative costs and characteristics of different reproduction techniques that might be applicable to some of the dissemination and massive processing problems of an information service?

What are the techniques and costs involved in keeping up and in using large mailing lists in taking care of distribution of journals, etc.?

What are relative costs of providing the information in micro form as against making original-size photo copies?

Of the currently operating abstracting services, how many are operating merely to satisfy an obligation of a professional society that would rather have somebody else do the abstracting?

What services does the Russian All-Union Institute really provide? What is the reaction of a Russian scientist to this information center?

How important is it to know what the rest of the world is doing?

Are any projects or areas of work reported almost exclusively in foreign literature?

What is the expected rate of growth of the system?

What are the potential information processing capabilities of existing mechanical devices?

What are the theoretical capabilities of existing or anticipated machine components which might be applied to the information processing problem?

How often will the system presumably be searched? How definitive will the search have to be? What volume of information should a search produce? How fast should the system respond?

CHARACTERISTICS OF THE INFORMATION SERVICE

As increasing data become available it will become possible to consider some of the last group of questions—those dealing with the desired or necessary operating characteristics of a comprehensive technical-information processing system. Certainly, the first system implemented would be of an interim nature using existing resources, which unfortunately employ largely manual techniques. However, ultimately it is inevitable, in view of the impressive advances made almost daily in information processing techniques, that a highly mechanized system will be possible.

How soon can an interim system be functioning?

How much can be done just by concentrating on abstract distribution and better dissemination techniques?

Would it be feasible for the abstracting publications to use a standard format and type font, such that mats (or something similar) could easily be distributed to other interested publishers, thus saving printing expenses?

What technical societies could cooperate to publish a single journal instead of numerous splinter journals?

What about the scale of the service? Does it have to be a big system or nothing?

Does having a large information service necessarily mean the physical collection of all activities at one central location?

Would a group of smaller centers, for specific fields, be of greater utility and more tractable?

Would a collection of special libraries be more useful?

What can a national service provide that is different than what is now available? Is this to be an entirely new type of service, a real advance in the state of the art, or is it to be just more and better of the same thing?

Will the system have a finite capacity? One system might work well with a few million entries, but be hopeless with a hundred million.

As the system grows in size, will it be possible to make changes easily in the classification scheme and bring the old coding into the new scheme?

If a private consultant, with need to know established, were to work on a Government project, how would he locate and procure pertinent classified material?

Will financial filtering of requests by a uniform fee structure by desirable or effective, or would it be necessary to make nonuniform fee structure so that there is essentially some priority given?

What means can be used to pry loose useful information that customarily doesn't get into the published technical information channels?

Will the service include a positive program to declassify material under security restrictions?

What is an acceptable delay in getting information entered into this system?

Will all material in the subject fields be included or will there be an editor or a censor?

Will an attempt be made to standardize the form of the material before it gets into the center? Does the material have to be on standard-size sheets or forms?

What happens when the system becomes overloaded? Should service to users just be late, or should the service just be less complete?

How can we protect against freezing the specifications until enough systems work has been done to make clear what would be optimal?

Will the policymakers make sure that the final methods chosen for a retrieval system are not influenced too heavily by the requirement of compatibility with past systems?

Will abstractions be done? What kind? Descriptive? Critical? Informative? How can we get good-quality abstracts? Should the service use volunteer abstractors directly or a staff of full-time abstractors? Or should it allow the various technical societies to organize their own volunteer abstracting services?

Will any effort be made to review old documents, and to remove or recode when necessary?

Is a standard (or artificial) vocabulary necessary? How much work will be required to design and institute such a vocabulary?

What techniques and devices can reasonably be developed and applied for facilitating such immediate requirements as printing, reproducing, storing, microfilming, billing, communicating, etc.?

What kind of a data-processing system will the service need just to keep track of its operation?

Would the information service keep a collection of the original documents?

What special precautions must be taken to store primary records? Would a duplicate file and collection be maintained to prevent disruption of service due to fires, or other catastrophes? How much would this cost?

What is the useful life of various forms of records? In use? In storage?

What will the information service physically provide in response to information requests?

Will the output be in English, or a code that must be translated?

Will microform copies be acceptable to the users? If not, what improvements need be made in order to gain user acceptance?

Will the information service output be in a form that the researcher can determine which of the documents are in a locally accessible collection?

Will the system give answers (e. g., "yes," "no," "5,000 tons in 1945," etc.) as well as references?

Why not periodically publish inventories of research in progress, to indicate what research projects are currently being undertaken in each specialty field, thus helping to eliminate duplication?

Will there be a special communication network in which workers in the various specialized fields can easily circulate working papers or "think pieces"? A central agency could maintain printing, listing (in appropriate subject-interest categories), and mailing facilities for this sort of service.

Will the information service be able to retain a file of questions to be asked of all new input material, thus providing up-to-the-minute data for standing questions?

Will it be possible to stimulate more writing of review-the-literature papers by qualified people in the various fields, in order to provide guides for other workers?

Can a partial search be made? (For example, can one-tenth of the file be searched and the results checked to determine if further searching is justified?)

Could the information service operate on a "just search one-half the file for me; I don't need a comprehensive search" basis?

What kind of communications network will be needed for the operation of the interim information service? Will it be accessible to anyone by telephone or other direct device, such that the searcher can interrogate the file directly and at will?

Would the service be available for browsing?

What technical-manpower drain would the proposed information service program have on other high-priority scientific programs?

What professional and educational background is needed for the personnel to operate the service?

Could university science students be used part time and during summers to help with the various processing tasks, as a means of alleviating the shortage of people with adequate technical backgrounds?

Will there be special training for abstractors and translators or for documentation and information specialists, etc.?

How much research is needed? What research budget is reasonable?

If an information service were established, how soon could present partial services by Government agencies be terminated and funds diverted to the service? Could some special activities in industrial libraries be eliminated?

These questions, by the very nature of their origin, are random and fragmentary. Even the full list from which they have been selected is far from comprehensive. However, we have found them a helpful stimulus as well as a disciplinary aid in viewing the technical-information problem in its broadest dimensions. We hope that others interested in this problem will be similarly served.

DATA NEEDED ABOUT INFORMATION SOURCES AND SERVICES

Before the designers of an overall information center can sketch in the outlines of the system problem, a large amount of data about the information input and the existing information services must be collected. Some of the kinds of essential data are suggested by the following:

What subject fields are covered by the various journals, books, and reports? And in each case, in what depth?

What are the physical sizes of journals, books, and reports? Page size, and number of pages? Frequency of publication? Kind and size of distribution? Cost or subscription price?

In what language(s) do the journals, books, and reports appear?

Does each have an index? Are abstracts published, and where? Where is the information indexed?

Who, principally, are the contributors to the technical journals? Who selects or reviews papers for publications? How long, generally, between preparation and publication?

Are microfilm copies of books, journals, and reports available?

Who are the publishers of technical journals, books, and reports? Where is each located? And how long in operation?

How is each publishing operation financed?

What are the policies and objectives of the respective publishers in each field?

What fields of science and technology does each publisher operate in? In what fields does each concentrate or specialize?

In what language(s) does each publisher produce his journal(s), books, or reports?

Could publishers of journals, books, and reports provide paper tape or other machine-readable copies of their works? At what cost?

How much has been produced to date in the various technical subject categories in journal, book, and report form? What is the physical mass of each? Are back copies available?

What libraries with technical collections, abstracting services, indexing services, and translating services are in existence? Where is each located? What is its organization? How is it financed?

What is the size and training of the staff of the various technical-information handling or processing organizations? In each case is the organization equipped to handle classified material?

In what field(s) does each information handling or processing unit operate?

What classification and indexing systems are in use?

What is the normal time between publication of a document and its appearance in the libraries? When is it abstracted? Indexed? Translated?

What are the types and numbers of scientific and technical people using libraries, and the abstracting, indexing, and translating services? In what ways does the technical community feel it is being adequately or inadequately aided by these services?

Would the various libraries and services be amenable to negotiation of changes or increase in area of coverage, or other changes of service, to fit a reasonable, overall system, if Government controlled and subsidized?

What are the charges for service by libraries? Abstractors? Indexes? Translators? Which of these services are self-supporting?

Are special compilations of abstracts, bibliographies, or translations available? And for what fees? How long required to provide such special services?

Is There a Technical Information Crisis?

By Merritt L. Kastens, assistant director, Stanford Research Institute

The problem of organizing technical information has received more study, particularly at high levels of the governmental and scientific communities, in the past year than in the entire previous era of modern science. Does this attention imply that the Nation is suddenly faced with a new situation arising from the Russian satellite program—some new pattern of circumstances that requires an immediate countering action in order to prevent losing the technological race?

Obviously not. Specialists concerned with the organization and dissemination of technical information have been pointing out for many years that the rapid increase in level of technological activities has far exceeded the concept and rate of growth of information processing facilities. Those who have responsibility for organizing and budgeting research and development efforts have been increasingly aware of the rising cost and frustrating inadequacies of the available mechanisms for finding recorded knowledge. The rapidly increasing accumulation of technical information and the lack of adequate organization for its utilization imposes an increasing economic burden on our society and threatens to drown our scientists and engineers in a flood of meaningless paper.

International events have emphasized the time dimension of present-day technology, and particularly the military significance of time. In technical development the major time interval is between the initial scientific discovery and the design of a prototype device. More time is lost—or more time is to be gained—between the laboratory and the drawing board than there is between the drawing board and the production line. In this period, where ideas rather than physical materials are involved, speedup is most feasible. Thus, from a military standpoint, the information system itself has become a weapon system. It is the weapon system on which all military devices as well as our peacetime progress, depend.

The problem is an old one. What is new is the general appreciation of its seriousness. Out of this arises hope that major steps toward solution may at last be undertaken. We can no longer afford the piecemeal efforts toward fragmentary solutions, which have been the only kind of efforts this problem has enjoyed in this country until now.

The acute awareness of the need arrives at a time when there is prospect for major help for solution from technology itself. Recent developments in machine systems for information storage and retrieval, although still far from adequate for the job at hand, are definitely encouraging. The technique of organized invention for the solution of practical problems has long since proved its efficacy in the applied-research laboratories of the world. The newer techniques of operations research, systems analysis, and applied behavioral sciences, are providing increasing evidence that an organized, systematic approach to very complex problems is effective, economical, and, indeed, may be the only feasible approach.

The cost of inadequate technical information processing facilities in duplication, in delay, in the failure to solve both military and civilian problems in the shortest time is real; it is large; it is constantly growing. The tools for the solution of the problem are available. Failure to use them now can only delay and make more difficult the effort ultimately required to prevent chaos in technical communications.

Dr. E. J. Crane, director and editor of the Chemical Abstract Service, Ohio State University, Columbus, Ohio.

Dr. Crane, we are very happy that you are ready to testify. You may proceed according to your own desire.

STATEMENT OF DR. E. J. CRANE, DIRECTOR, CHEMICAL ABSTRACTS SERVICE; EDITOR, CHEMICAL ABSTRACTS

Dr. CRANE. Thank you, sir.

Mr. Chairman and members of the committee, as editor of Chemical Abstracts during 43 years, and as a member of its staff—this is my 48th year on its staff; I have been in charge of the work for 43 years—I have had a lot of experience. If I can answer some questions as to what is being done to solve the problem that is under scrutiny, what is being done to help scientists, chemists in particular, I should like to do so. I have no other purpose.

I feel as if a rather gloomy picture has been drawn by a witness or two. I feel as if the comparison with what is being done in the Soviet Union is hardly a true picture. The United States is not lagging behind the Soviets in this matter of dealing with scientific literature. I think I can present some information that will justify that statement. Better methods of dealing with the literature of science are of course always possible.

There has been a realization in this country for many years, for over 50 years as far as the American Chemical Society is concerned, that there is this problem. We have been working at this sort of thing, as I say, for half a century. And we have a successful service for chemistry. I say "successful" because, while the prices keep increasing, it keeps selling. It is widely used. It wears out in libraries.

The British scientists had such a service but gave it up in favor of Chemical Abstracts. There is such a service in Germany. Within recent years there has been such a service in Russia.

Incidentally, I mention of the Russian abstracting and indexing service that it is the fourth attempt in the last 30 years to have such a service in that country. The others have failed. The present Russian chemical abstract journal is not without faults. It is lacking in one very important respect. While it is in its sixth year it has no published subject index as yet, no key to all the information that is in it.

Chemical Abstracts publishes annual indexes. This 1,200-page copy I hold in hand is one-third of the annual index. I didn't try to carry the complete annual index. This other copy is a number of Chemical Abstracts, one issue, the latest issue; it contains about 500 pages and about 5,000 abstracts. This journal appears twice a month, every 2 weeks, approximately. It is widely used. It is carefully indexed. There is a key to it. It is possible to get at the information.

We get out not only annual indexes but collective indexes at 10-year intervals. This I now hold up is the first volume of 19 which will cover the chemical literature of the world for the past 10 years. This complete index will contain about 21,000 pages, and there will be 19 separate volumes.

This 10-year index is in demand. It is an expensive undertaking, but it is clearly in the black. This journal (Chemical Abstracts) is also in the black, which shows that there is really something being done in America about this sort of thing with demand for the service and wide use of it.

Senator HUMPHREY. Dr. Crane, may I interrupt at this point? It is generally recognized that Chemical Abstracts is about the finest service of its kind. I think of all the abstracting services, the report of the staff notes that this is perhaps the leading operating and privately abstracting scientific service in the field.

I am not one of those who go around thinking that the Soviets are ahead of us. I don't try to judge American standards on the basis of what somebody else does. I think we ought to have our own standards. I believe in being out about 200 percent ahead of everybody else, a good, safe, sure distance.

But isn't it true that the Soviet service covers some 13 science or scientific fields? The question is, do we do as well in all the fields of science as you do in your Chemical Abstracts? You happen to have an outstanding service with a fine reputation with many years of efficient production and competency.

What about the other areas? What about metallurgy and biology? What about the broad areas of a dozen other fields of science? Do we do as well in abstracting these as you folks have done in Chemical Abstracts?

Dr. CRANE. My purpose in telling about Chemical Abstracts was chiefly to establish my right to an opinion. I have no wish to make comparisons or boast of Chemical Abstracts. There are good abstracting services in this country, a number of them. I don't believe they quite cover the full range of natural science.

I have here a list at the back of my statement of some of the more prominent American abstracting services. These are good services. I do realize—I have been told, and I think it is true—that some of them are not as complete as they should be for lack of funds. Completeness is an important characteristic of an abstracting and indexing service.

It should be possible for a researcher to look in one of our indexes for the year and look for the references under a given heading and have a feeling that that is everything that was done during the past year. And I would say right there, there isn't any lag of 7 or 8 years, as mentioned.

Senator LAUSCHE. I wish that you would go into that a little bit more, because I am sick and tired of praising the Soviets at all times and depreciating our own country. If you have any information on this subject that you would like to give, I wish that you would give it at greater length.

Dr. CRANE. Yes, sir.

Senator LAUSCHE. What is your knowledge of the Soviet centralized UKASE system?

Dr. CRANE. I am acquainted with the editor of the Russian chemical abstract journal. He told me frankly, when I met him in London, that the abstract journals in Russia are copied after Chemical Abstracts. I don't have that in writing, but that was an opinion expressed.

I mentioned that they do not have an index. Here is a copy of their journal. It is perhaps not more than 50 percent useful for lack of a key to what is in there. You can bury information in a book like that, that appears every couple of weeks, without a key to it.

They have author indexes. There is no subject index to this Russian journal now in its sixth year.

Senator LAUSCHE. The book that you are referring to is an actual supposed digest issued by this central office in Russia; is that correct?

Dr. CRANE. Yes, that's right. That is a copy of it.

They have no subject indexes for the chemical series so far. They have subject indexes which lag several years for some of their services;

Here is one of their annual indexes for mechanics. Mechanics is not as extensive a field as is chemistry. But compare that with, say, two more books like this. As a matter of fact, we will have four for 1957. Compare that Russian quarter-inch index with a stack that high [indicating] about 8 inches and you can get some idea of the degree of thoroughness of their indexing.

I have in my office some very fine indexers, men with high training in chemistry, doctors of philosophy, in fact—I use the very best—who have studied these indexes. They are inadequate. They are not up to date. They don't know how to do it well, so far. Maybe that is natural. We have been doing indexing in chemistry for 50 years.

Senator LAUSCHE. Who is this man you met in London?

Dr. CRANE. His name is Serpinsky.

Senator LAUSCHE. What is his official position?

Dr. CRANE. He is the editor—his title corresponds to mine—the editor of their chemical abstract journal.

Senator LAUSCHE. What function were you attending at the time you met him?

Dr. CRANE. I was attending an international congress on the literature of applied chemistry organized in London.

Senator LAUSCHE. It was confined to applied chemistry?

Dr. CRANE. Yes, it was.

I met the man in other places, too. There is an organization known as the Abstracting Board which was organized by the International Council of Scientific Unions. I am the representative for the English language and for chemistry on this international board. This man, Serpinsky, is a member of that board. He hasn't attended the last 2 years' meetings. I don't know why. I used to have correspondence with him. This has stopped.

Senator LAUSCHE. You can leave my thought at this time, as far as I am concerned.

Senator HUMPHREY. May I ask, what do you think is the value of these Russian translations? Do you do any translations from the Russian?

Dr. CRANE. No, sir; we don't count them as translations. We have men who are well-trained in the fields represented by the various Russian papers, who make informative abstracts—you will find plenty of them in here—of these Russian papers. They read them in Russian and then, in their own language, in English—their own words in English—they prepare these informative abstracts. Since they are rather long informative abstracts, as a rule, they serve the purpose of providing that information to the chemist for most of his needs. However, sometimes a man who is particularly interested in an article will want all the details.

Senator HUMPHREY. Which he can get?

Dr. CRANE. Which he can get without too much trouble.

Senator HUMPHREY. What you do is give an English abstract?

Dr. CRANE. Yes.

Senator HUMPHREY. An abstract in English of the article that may appear in a foreign language, whether Russian, Japanese, or whatever it is?

Dr. CRANE. Yes, sir.

Senator HUMPHREY. And then the reference is included as to whether the original work is available for the chemists?

Dr. CRANE. Yes, sir.

Senator MARTIN. Do your staff members do that here at your home plant, or do they travel overseas?

Dr. CRANE. We have 1,600 abstracters who are scattered all over the world. Most of them are in the United States. They are not full-time workers. They are people who are actively working in some branch of chemistry. A man might be working on rubber chemistry and he is the kind of man who can make a good abstract in that field. He knows the subject, he can judge as to what is significant and what is new in a paper, put it in an abstract, and that is the only kind of a man who is really a good abstracter. That is why I think it would be unwise to try to do abstracting in a centralized service. Professional abstracters wouldn't have the background to decide always what is significant and new to put into an abstract.

We use men who are actively in the fields represented by the subjects covered, and gather in their abstracts.

For example, we have 75 abstracters in Japan. The Japanese language is a difficult language. These 75 men represent various phases of chemistry. They make their abstracts for us and we assemble them in Columbus and index them very carefully. Half of our effort is put on indexing. So that there is a key to this information. If a man wants to know what has been done on the chemistry of rubber you will find page after page in here on rubber.

The question of lag has been brought up. Of our abstracts it can be said that it takes about 5 months on the average to get an abstract in print. You must get the original, get the abstract, get it carefully gone over and edited, sometimes enlarged, and get it in print. It averages about 5 months to do these things. Our indexes are not as prompt as we would like them but they are much more prompt than the indexes of other services of a similar nature across the seas. I think they are produced more promptly than some indexes in this country. Ours is a big, thick pile of books, highly technical (approaching 5,000 pages annually). It is even a 6-months printing job. So the lag is not great.

Senator MARTIN. Are the records that your staff members need available, accessible, to your members throughout the world, in all countries?

Dr. CRANE. The original documents, you mean?

Senator MARTIN. Yes.

Dr. CRANE. They are in the libraries of the world. They are practically all here in Washington, most of them in the Library of Congress. Of course, there are special types of libraries here, like the Armed Forces Library, the Department of Agriculture Library, and so forth. Many of the more important journals are in the libraries scattered through the country.

This question of interlibrary loans was brought up this morning. There isn't much dependence on interlibrary lending any more. The photocopy has taken its place. A man who wants a copy of a paper, a full paper, a full document, can write and get a photocopy rather quickly and rather inexpensively.

There is a block there. The copyright law makes copying illegal, but it is done anyhow. I think the copyright law really should be revised in that respect, to enable the scientist who needs this information for the country's good, for his research work, to be able to get

a single copy for his scholarly purposes without going against the copyright law.

Senator HUMPHREY. I notice in your testimony that you speak of the National Federation of Science Abstracting, and Indexing Services, which was organized this January.

Dr. Crane. Yes, sir.

Senator HUMPHREY. Do you think that that federation offers some possibility for the improvement of the availability of these informational and technological services?

Dr. CRANE. Yes; I think it does. It is a very new organization. But that is what some of us had in mind in organizing this federation. We have an organization that is completed now, but has not been in operation as yet. This list I give you here is the list of abstract journals which were represented. Some of these abstract journals need financial support. I say "some" because I know that Chemical Abstracts at least doesn't ask for help. Some of these abstract journals are unable to cover their fields completely for lack of sufficient money.

We are more fortunate in chemistry because there is a strong chemical industry behind a strong profession and we sell our service at a rate which pays for it. Some of these services are struggling for lack of money.

There is a great deal of money put into research these days. Each research project results in the publication of reports, papers, sometimes many papers. Often there is no thought on the part of the people, of the Government, or whoever furnishes the money as to the publication of the research results; they overlook the fact that really a research project is not of much value unless it is published and unless the information in it is keyed in some such way, as by abstracts and indexes, so that the information is available when it is needed.

Scientists must have a journal like Chemical Abstracts for their fields to read, and this must come to them regularly—the American Chemical Society sees that the members of the society get chemical abstracts quite inexpensively—to look through. The abstracts are classified. The chemist can look through the parts that he is interested in, read them and keep informed. And if he has a problem he goes back through the abstracts led by the indexes, back through the years, if necessary, and gathers together all that is known on the subject.

Senator MARTIN. This volume here is the letters "o" to "z" on the subject index?

Dr. CRANE. That's right.

Senator MARTIN. What does the total service cost a subscriber?

Dr. CRANE. The subscribers pay $350 for chemical abstracts but members of the society can get it for $20 if they will agree to use it for their own use only. We have what we call "multiple users," which are libraries and industrial firms. The restriction on use placed on the $20 subscriber is necessary in order to get the backing needed by selling the $350 subscriptions for multiple use. We have to have that money to operate.

I haven't followed my notes or my statement very much.

Senator LAUSCHE. Might I suggest that he proceed now with his notes and cover those phases of it which he hasn't thus far covered.

Senator HUMPHREY. Of course we will make the entire statement a part of the record as though read.

(The statement referred to is as follows:)

STATEMENT OF E. J. CRANE, DIRECTOR OF THE CHEMICAL ABSTRACTS SERVICE AND EDITOR OF CHEMICAL ABSTRACTS

Mr. Chairman and members of the committee, I have accepted this opportunity to testify with the hope that, from long experience as editor of Chemical Abstracts, I may be able to supply some helpful information with reference to the handling of scientific information. I have no purpose other than to share information.

To begin with perhaps I should mention that Chemical Abstracts is a nonprofit undertaking of the American Chemical Society, which has a Federal charter and is the largest scientific organization in the world (83,000 members). Chemical Abstracts is in its 52d year. As a member of its staff during 47 years (in charge 43 of these years), I have seen the work grow till now we publish approximately 10,000 abstracts per month covering almost a thousand large, fine-print pages. These abstracts are prepared by 1,600 chemists scattered the world over and edited and indexed by a staff of over 200 editors, indexers, and clerical assistants. The new chemical information obtained comes from 85 countries and appears originally in 8,000 scientific and technical publications printed in over 40 languages. Our annual indexes require 5,000 pages now and our latest 10-year index will consist of 21,500 pages bound in 19 volumes. The interest of chemists in Chemical Abstracts is such that we annually get about half a million dollars worth of freely contributed service. Still our 1958 budget is $1,676,520 for the journal proper and we have a $2 million extra budget for our current 10-year index.

Science is recognized today more than ever before as an important factor in national strength. Science thrives only in a climate of free interchange of information. Progress is made from a frontier which marks the current state of advance. The next steps can be taken effectively only by scientists who have learned of the essential past steps of others as a starting point. Few races are won by scientists who lag behind in preparation instead of keeping informed up to the minute in their respective fields of scientific activity.

From year to year, it grows more difficult for scientists to keep abreast of advances made by others the world over. The quantity of modern scientific research is enormous. Probably as many as half a million scientific papers reporting the results of investigation or research now appear annually. About one-fifth of these are of chemical interest. The scientist must not only do much current reading, but he must also do a good deal of digging into the literature of the past as new problems arise.

It is characteristic of scientists under most circumstances to share their research results by publication.

Publication is not enough.

Translation is not enough.

Abstracting is not enough.

To complete the efforts to make this mountain of information available for use, good indexes must enter the picture. I mean the kind of indexes which serve as keys to every bit of recorded new and significant information.

All of the above steps (publication, translation, abstracting, and indexing) are essential to availability for use, with translation often the least significant factor. I shall discuss translation below.

I emphasize the importance of good indexes, not just lists of titles, but effective keys to all the information in publications. Sometimes their significance is overlooked or not given adequate recognition.

About one-third of Chemical Abstracts' present annual output of pages (approximately 15,000) is devoted to indexes, the other two-thirds being devoted exclusively to abstracts. The building of these indexes requires half of out effort, and we consider that they have at least as much value as have the abstracts. Both must be furnished for effective service. Information is buried even in a collection of classified abstracts without good keys. Chemical Abstracts publishes 5 kinds of indexes, and these all appear both annually and at 10-year intervals, with a limited amount of indexing in current issues of the journal.

It is important that an abstracting service for a given field be complete in its coverage. Completeness involves (1) the reporting in abstract form of all publications containing new information (papers, patents, books, miscellaneous bulletins), (2) the making of each abstract complete from the indexing point of view, and (3) thorough and thoroughly good indexing.

Translation has been spoken of as a lesser factor because approximately half of the scientific literature of the world appears in the English language and because most well-trained scientists can read at least German, French, and English. It will be clear from the table given in the following paragraph that this takes care of the greater part of scientific literature with the exception of that appearing in two languages, namely, Russian and Japanese.

The following small table shows roughly the relative degrees of scientific research activity in the various industrially developed countries of the world.

Countries:	Percent	Countries—Continued	Percent
United States	28	France	6
Soviet Union	14	Italy	4
British Commonwealth	11	All others (78 countries)	19
Japan	10		
Germany	8	Total	100

These figures are based on counts of abstracts appearing in Chemical Abstracts. Chemical Abstracts has long undertaken to cover the world's chemical literature completely. Chemistry is a fundamental science much used in the experimental work of all other branches of natural science. It has been repeatedly conceded that the numbers of abstracts in Chemical Abstracts of papers published in each of the various countries of the world do serve as a rough measure of the relative degrees of scientific research activity of these various countries.

The Soviet Union has gained second place in such activity only within the last year or two. It will be noted, however, that scientific research activity is approximately twice as great in the United States as in the Soviet Union. I do not believe that our coverage of Russian scientific literature has been inadequate, nor do I believe that there is any more withholding of scientific information in the Soviet Union than there is in the United States. More will be said about our Russian coverage later.

The strong positions of the Soviet Union and of Japan in scientific publication does present translating problems.

An increasing number of scientists in the United States and in Europe are learning to read Russian. In time this will decrease the need for the translation of Russian scientific publications. Many such publications are now being distributed in translated form. This is no doubt a justified present practice though it is my belief that in the long run the publication of translated editions of overseas scientific journals is neither an economic nor a justifiable practice. Most scientists and many libraries cannot afford to pay the high subscription prices usually placed on translated journals. With research strongly on the increase the financial load on individuals and libraries for journal subscriptions is already overheavy. The publication of good informative abstracts takes care of much of the need. Scientists have never had too much trouble in obtaining translations of the occasional articles for which full detail is needed. In most centers of scientific activity, as universities and Government laboratories, there are individuals who can help out when a scientist needs help in figuring out a needed portion of a paper reporting new scientific information in a foreign language.

Scientific publications are for the most part the property of scientific societies, private publishing houses, or governmental agencies. Most of these depend for needed financial support on the selling of subscriptions, not only at home, but also abroad. While translation and distribution without permission may be justified in an emergency, there is some question as to the ethics of this step and as to the wisdom of it without compensation to the owners of the publications being translated. The tendency of translating practices will be to stifle and weaken scientific publication, so essential to progress.

Japanese scientists recognize the special difficulties presented by their language and tend to publish complete papers in English, French, or German (usually English during the past few years) or to publish full abstracts in one of these languages along with their papers. Chemical Abstracts has a staff of 75 abstractors over in Japan who provide informative abstracts of all chemical papers published there.

In the Soviet Union, strong emphasis has been placed during the past few years on making scientific information available. This alert effort has taken the form of the establishment of the Soviet All-Union Institute of Scientific and Technical Information and the organized publication of 13 scientific abstract journals, each for a different branch of science. This development has been associated by some with the spectacular early launching of earth satellites by the Soviet Union.

Some have concluded that the Soviet Union is ahead of the United States in effective efforts for making scientific information available to its scientists for use. The Soviet progress in handling scientific information is significant and I do not belittle this when I say that like literature-handling service in the United States has not been surpassed in effectiveness. I shall endeavor to substantiate this statement by information given in the following paragraph.

The Russian abstracts are good, but they have thus far been appearing somewhat late. The Russians have organized to cover the whole field of science with abstracts more systematically than this kind of work is organized in the United States, but they are not publishing more abstracts or better ones. Chemical Abstracts has thus far covered the world's chemical literature more fully and in general more promptly. This includes the chemical literature of the Soviet Union. A comparative study of Referativnyi Zhurnal, Khimiya versus Chemical Abstracts shows that we have been abstracting directly from the original Russian publications 92 percent of the papers covered by the Russian chemical abstract journal with many of our abstracts appearing first. The remaining 8 percent of Russian papers are being covered by use of the Russian abstracts after translation (with permission and with credit). The reverse also is true. They translate and publish some of our American abstracts for a like reason.

Above I have emphasized the extremely important role played by good indexes in making abstracted scientific information truly available for use. It is in this connection that American accomplishment is far ahead of Russian accomplishment. For example, the Russian chemical abstract journal is now in its sixth year without having published a single subject index. Such indexes have been promised, but none has appeared as yet. I would say that their journal is no more than half useful for lack of such indexes.

For the various Russian abstract journals, indexing is either lacking or lagging. The quality of the indexes is poor. For example, for the field of physics, the latest annual index published is for 1954 and the index is meager in coverage. It averages less than two entries per abstract whereas the Chemical Abstracts Subject Indexes average six entries per abstract. For all kinds of indexes (subject, author, formula, patent, and organic ring) our abstracts average 12½ index entries annually and these entries are repeated at 10-year intervals in collective indexes.

Incidentally I mention that I have had direct word that Referativnyi Zhurnal, Khimiya has been modeled after Chemical Abstracts. This Russian chemical abstract journal is the fourth attempt at the publication of such a journal in Russia during the past 30 years. Previous efforts have failed. The American Chemical Society's Chemical Abstracts is now in its 52d year of continuous appearance. While the Russian effort as to abstracting and indexing is a government undertaking, the Russians recognize the fact that for effective work the abstracting help of scientists actively doing research and other work in their respective fields is needed for good results. This is the method of Chemical Abstracts. These active workers in specific fields of investigation are the only scientists qualified to recognize what is new and significant in papers and therefore what information to put into the abstracts made. Also by knowing their fields expertly, these informed abstractors usually avoid misleading mistakes. Good informative abstracts cannot consistently be made by professional abstractors. The Russians are said to have tried using professional abstractors, and to have changed over to the use of the help of part-time scientists who devote most of their time to the kind of work in their fields which keeps them in tune for good judgment in abstracting.

Because of what has just been said about the need for scientists active in their fields to participate in the recording of the information of their fields by abstracting I believe that abstracting and indexing in the United States should remain largely in the hands of the scientific societies now sponsoring most of it. These organizations can best and most economically gain the interest and help of their members in such work. This is the American way of doing things. In some fields such as meteorology, nucleonics, and perhaps agriculture, where a large percentage of the scientific work is done by governmental agencies, the situation differs. In general, I do not believe that we should imitate the Russians in the establishment of one great governmental abstracting and indexing organization. This would not be as effective as our present services are or can be. What I say does not mean that I think our Government should avoid taking a direct interest in the handling of scientific information.

In chemistry, where we have the backing of a strong profession and the industry based thereon, no help is needed. None is requested. The American abstracting services for some branches of science need financial strengthening to make it possible for their coverage to be adequate. In a few scientific fields, such as astronomy, there is no American abstracting service. Finding a way to provide such a service would be beneficial to the American scientific position.

The important field of physics is served by a British abstracting journal (Physics Abstracts). This British journal is good, but it is said not to be quite as complete as it should be and it is not as well indexed as is desirable. The situation in physics is not bad, however. This is true because, in addition to this good British journal (American physicists cooperate in its production) there is a good German physics abstract journal. Furthermore, Nuclear Science Abstracts covers much of modern physics, and Chemical Abstracts covers at least three-fourths of the papers appearing in the field of physics because these have more or less direct chemical interest.

To undertake in one single abstracting and indexing service to cover the whole field of science, either completely or for part of the world, would be inadvisable. The product would be clumsy and ineffective. Even with good abstracts and indexes limited to their own fields keeping up with the literature requires a significant portion of the time of scientists. If they had to wade through great accumulations of abstracts for all branches of science and through indexes cluttered up from their viewpoints with entries for other branches of science their abstracting and indexing "handy tool" would become definitely unhandy. Furthermore, the effective indexing of a branch of science requires highly trained workers who must strive for consistency above all else. A conglomerate of scientific indexers working toward the building of an index to a conglomerate of abstracts for all branches of science could not produce a consistent or a consistently good index. Each branch of science needs to be indexed from the point of view of that branch.

In January of this year, representatives of the larger American abstracting and indexing services (14 of them) met in Philadelphia to consider the advisability of the formation of a cooperative organization. This meeting resulted in the formation of the National Federation of Science Abstracting and Indexing Services. This organization should have value as a means of pooling information and research as to methods of operation and it is hoped that it will be in a position to facilitate the strengthening of those abstract services which are incomplete and the initiation of new abstracting and indexing services where need exists. If a practicable method can be found, this organization, consisting as it does of nonprofit services, some in government, but mostly outside of government, should be able to help in the needed strengthening of American science through the making of still more of the world's repidly increasing scientific store of information available for use by American scientists. This effort does require financial backing in some areas. I do not pretend to know how the solution of this national need can best be met in practicable form, but I do feel sure that the scientific organizations should remain in the picture for good results economically obtained. Some consideration should be given to the question of the advisability of governmental financial support here and there.

There is some international cooperation as to abstracting and indexing. As editor of Chemical Abstracts I am the representative for chemistry and the English language on the abstracting board organized by the International Council of Scientific Unions. This is a cooperating, not an operating board. The board does not publish any abstracts or indexes. There are ways of helping each other on an international level. The Soviet Union is represented on the board, but has been inactive recently.

I believe all will agree that our Government is much interested in scientific research. This provides the road to progress and strength. Much governmental money is invested nowadays in scientific research. I submit with strong conviction that funds made available for scientific research, no matter what their source, should include a certain small proportion of this money to pay for publication of the results obtained (primary publication) and for the abstracting, indexing, some translating, and other steps (secondary publication) necessary to make this information available for use. Primary and secondary publication is properly an essential part of a research project. More and more money is being made available for research. The individual scientists and the struggling libraries now bearing most of the cost of primary and secondary publication are getting more and more in difficulty because they lack the means of carrying the publication load through subscription money. The Russians are showing recognition of this need to make research projects complete by adequate primary and secondary publication. I believe that our own Government will be wise in finding a means of helping solve the dilemma presented by increasing amounts of money available for research alongside of meager funds available for making the results obtained available for use. I repeat my statement that science thrives only in a climate of free interchange of information. Such interchange cannot be free without a reasonable attitude toward secrecy, without strong journals able adequately to publish the results of research, and without sufficient funds available for the

essential abstracting and indexing which make it possible (the situation would be hopeless otherwise) for scientific research workers and others to keep up to date and to put their hands surely and readily on existing information when needed.

I compliment the committee on recognizing the general situation which I have tried to outline. I do not know all of the answers by a long ways, but I hope that out of a lifetime of work with Chemical Abstracts, I may be able to be of some help in pointing to pitfalls, in calling attention to tried and proven methods, and in emphasizing the kinds of need. In particular I would like once more to emphasize my belief that the active and responsible participation of scientists themselves in handling the literature of their branches of science is not secondary to the need for more financial support for primary and secondary publication if effective use of the scientific information obtained is to keep up with the present feverish scientific research activity.

May I add that some of the research activity should be expended on methods of recording and retrieving scientific information. This is worthy of governmental support. There is much interest these days in the possibility of mechanizing the recording and retrieving of scientific information. This problem has not been solved as yet for more than special and restricted areas and purposes. Chemical Abstracts has an active research department and the American Chemical Society has budgeted more than $100,000 in 1958 for research on methods of dealing with scientific literature. Further study of the handling of scientific information by machines is highly desirable. The problem is extremely difficult. The time is not ripe to place significant dependence on such a method for broad fields of knowledge.

Abstracts and indexes will continue to be needed when the mechanization problem is solved. Both methods will serve useful purposes.

Senator HUMPHREY. We are very anxious to get Mr. Crane's views as to what role he thinks the Federal Government should have in this service. That is the central question we are asking ourselves here.

Dr. CRANE. Shall I answer that?

Senator HUMPHREY. Take it in the steps you wish.

Dr. CRANE. While I am not exactly defending what has already been done, I am trying to paint as true a picture of the situation as I can from actual living with this sort of thing for so long. I don't want present abstracting and indexing practices to be discounted. I am not against finding better methods. We have been trying to help find them. We have a research department of our own. This year the American Chemical Society will spend over a hundred thousand dollars on research on methods of dealing with scientific information, maybe by mechanization some time. The mechanization problem hasn't been solved but, we hope, may be.

I think that there is need for some kind of governmental cooperation. I like Senator Lausche's use of the work "catalytic." I think the Government might well catalyze the work to gain better overall coverage and to better the methods. Some Government financial support is desirable in certain areas because research is a stupendous thing these days.

We have heard of $7 billion, or $8 billion, being spoken of as being spent annually now for research. That puts an awful load on the scientists and libraries who back the publication, abstracting, and indexing of the results by subscription. It would be a matter of national strengthening to help these people who cannot do as well as they know how merely for lack of money.

I would like to say at this point that I think the scientific societies, the organizations consisting of the sceintists themselves, whatever their fields may be, are the people to produce these services, because they know how and they pitch in and help. Naturally it is to their own benefit. They take a great interest in these things. We get—and this is

literally true, gentlemen—we get probably half a million dollars worth of service annually without paying a cent, just because chemists are interested in helping Chemical Abstracts. It is theirs and they know the value of it. I have mentioned the 1,600 abstracters who help.

I should think that the Government might support research on methods. What is really the greatest need of all is research on better methods of dealing with information recording and retrieval.

I don't admit that we have been asleep. We wouldn't be successful in this business for 50 years if we weren't always looking for better methods. We have improved through the years. But the job is getting very heavy and it is true that looking up the literature is expensive, is time consuming. I don't think the little fellow, by the way, is being left out, because the little fellow can make his own search and lots of times he can do it better than others can do it for him. He grows as he looks in these indexes and abstracts and he gets new ideas as he sees unsought entries and turns to something that he hasn't thought of before or that he wouldn't think of if he had the opportunity only to ask a question of some center.

So there is a role for the scientist to play in producing searching aids and in using them. This statement doesn't mean that I disagree with the idea of some centralized help. Maybe the National Federation of Science abstracting and indexing services can be of value in that connection. But this organization has no money. It may be able to advise, to evaluate needs, and to cooperate with a national center.

Senator MARTIN. Is the subsidy you are speaking of, the subsidy you are recommending, a subsidy for management of this program or for the research staff or for the customers?

Dr. CRANE. I can see need for all three kinds. I think that research is the main thing. There are organizations represented here which have discussed that question of need for research. There are organizations which need some support in research work on methods.

Senator MARTIN. In other words, the Government would encourage young students in the field of chemistry, for instance, to go into extensive research?

Dr. CRANE. I don't know that students could to this. It requires a higher order of training. I think that research groups need some backing in this sort of thing. It will be of national value.

Senator MARTIN. I didn't mean undergraduate students. I consider a man a student even though he has several degrees.

Dr. Crane. Yes, that is true.

Senator MARTIN. A true researcher isn't limited by having a few degrees after his name.

Dr. CRANE. Yes, sir, you are right. I am sorry I misunderstood.

Then you asked about consumers. I know that some of our libraries are not able to purchase as many publications as they need, as the scientists of the Nation need for use. This matter of translating, say, the Russian publications, is complicated because these libraries must get the original and then they must get a translation, and the translation is more expensive than the original, a good deal more expensive, as a rule. Some of them are restricted. So it could very well be that some libraries might be subsidized.

Senator MARTIN. What do you mean by "restricted"?

Dr. CRANE. They haven't enough money, so they cannot get everything that they need.

Then, I think some of these existing abstracting and indexing services need support so that they can cover their fields more fully. They have the ability to cover their fields now but they don't have enough money, say, to publish 50,000 abstracts a year, if that is the number needed to cover a branch of science adequately.

Furthermore, there are a few fields of science, a few branches of science, in this country which are not covered at all. Astronomy is one of them, for example.

Senator MARTIN. Wouldn't you say that most all branches of science could use this encouragement for extensive research?

Dr. CRANE. Yes.

Senator MARTIN. That is not confined to any one. It is pretty general?

Dr. CRANE. Yes, I think so. I mentioned Chemical Abstracts as being in the black. We are not looking for anything, for funds. We are interested in helping in research work.

Senator MARTIN. I did not know until you came here that any work was so fully organized as far back as 50 years. I asked a few questions the other day about how extensive the private development has been in this field in the entire range of science. I need a lot of information of how far we have gone.

Dr. CRANE. This list here is just an indication. There are other abstracting services.

I have been heartened to realize, to learn how fully the members of this committee appreciate the value of science to national strength. I have wanted to emphasize that the publication of the information learned is not enough. Abstracting is not enough. Translation is not enough. To complete the effort, very good indexing, truly scientifically done, is desirable, because after all a good key to the information is needed. I have mentioned that that is half of our task.

I have mentioned completeness.

I don't think I will take time to discuss translation except that I think that this matter of translating foreign journals should not be a matter for all time. I think it may be desirable for special circumstances. I mention the cold war, for example. But there are several reasons why translation is not economical, and I am not sure that it is ethical. A scientific journal is the property of some organization, some society, some publisher. He is able to publish it because he sells subscriptions.

One-fourth of our subscriptions are from overseas, by the way. If somebody takes a publisher's property, translates it and distributes it, unless the translator pays for that privilege, translation for distribution isn't truly ethical in my opinion.

Science must be published. There must be primary and secondary publications. Indexes and abstracts are secondary publications. In order to publish, a publisher must be able to sell his product. If somebody just takes it and translates it and sells it, the publisher's number of subscriptions are cut down, and he has to cut down his journal or charge more for it to break even. This makes it more difficult for his own people to get the publication to use. So that it isn't a good overall practice.

Senator MARTIN. That is why I was so curious about your recommendation about the management level of your organization. I would need information as to how the Government could help your enterprise without harming your enterprise.

Dr. CRANE. As I mentioned before, we are not asking for help. We are on our feet and in the black.

I have a table here that I think is of interest to you gentlemen. It is on page 5 of this statement. It shows that 28 percent of the scientific research of the world, approximately—these are rough figures—is done in the Untied States; approximately 14 percent in the Soviet Union; and so on down the line. The Soviet Union was not always in the second position. The Russians are gaining, but they are only about halfway up as far as the United States is concerned.

The only nations that present a serious translating problem are the Soviet Union and Japan. The Japanese publish much of their material in English. They publish long abstracts of their material along with the original, so that Japanese translation is a lesser problem.

Many scientists now are beginning to learn to read Russian. It is not easy but it is not impossible.

I don't want to take your time to substantiate those figures unless you want me to.

Senator LAUSCHE. Mr. Crane, are these figures predicated upon the portion of activity taking place in the chemical science?

Dr. Crane. Yes.

Senator LAUSCHE. So that it is in the chemical research where the United States is doing 28 percent, the Soviet Union 14 percent, the British Commonwealth 11, and Japan 10, and so on down the line?

Dr. CRANE. Yes, sir. However, chemistry is a fundamental science, and chemical methods are used in a great many branches of natural science. So that we do much of our abstracting from other fields. We abstract three-fourths of physics and a great deal of biology, which involves chemical methods. People have often conceded that these figures, based on counts of our abstracts—you see we try to be complete in our coverage, and I think we approach it—people have conceded that this is a rough measure of scientific activity in general.

Senator LAUSCHE. On the whole?

Dr. CRANE. Yes, sir.

Senator LAUSCHE. That is, if in the chemical field, and those other related sciences which you have studied in your indexes, if that shows 28 to 14, your inference is that that is generally applicable to the overall activity?

Dr. CRANE. Yes, sir.

Senator LAUSCHE. In scientific research?

Dr. CRANE. I think that is true. Roughly. Very roughly.

Senator MARTIN. May I ask this question: Do you have similar breakdowns of percentages for the years back?

Dr. CRANE. I do have, and I can send them to you. I don't have them here.

Senator MARTIN. I would like to have just enough to know where these countries rated a few years back. I don't know the industry well enough to know what years would be significant years or how far back it would be necessary to go to show the trend. I had in mind here Germany's present showing of only 8 percent, which surprises me

Dr. CRANE. Germany, when I started in this work in 1911, was strongly at the top. It gradually came down as the United States went up. After World War I Germany was second for a little while. But Germany came up and went beyond the United States between the two wars. Then the United States came back.

Senator MARTIN. I don't want to burden you unduly in looking back but I am curious as to what the trend has been between nations.

Dr. CRANE. I will send you a note on that.

Senator MARTIN. Thank you.

Senator THURMOND (presiding). Are there any more questions?

Senator MARTIN. No, sir.

Senator THURMOND. Senator Lausche?

Senator LAUSCHE. I would like to have him continue because his knowledge is so deep in this matter.

Senator THURMOND. Dr. Crane, will you proceed?

Dr. CRANE. You might like to have this as an exhibit. I have here a translation of a paper written by a Russian, descriptive of and in criticism of what the Soviet AEC-Union Institute of Scientific and Technical Information is doing in its abstracting service. The man who wrote this takes the Soviet effort to pieces. I think that would be of interest. If you like I can leave these as exhibits.

Senator THURMOND. It will be inserted at the conclusion of your testimony.

Dr. CRANE. America is not lagging in the coverage of Russian literature as far as chemistry is concerned. We made a study recently which showed that. We took this Russian chemical abstract journal and we took Chemical Abstracts and found that 92 percent of the abstracts in the former from Russian sources were in Chemical Abstracts. We have made up for missing the others. We have ways of obtaining abstracts for the other 8 percent. That is being done continuously.

Our abstracts in America of Russian material were appearing many times ahead of abstracts in Russia of their own corresponding papers which, furthermore, are not yet indexed by the Russians.

I have no desire to belittle the Russian effort. I just want to see that the picture is properly understood as I see it from a lot of experience and from some real study.

I don't think we should imitate the Russians. We should strenghten our effort by some kind of coordinating or catalytic service.

I would like to make the point that one single abstracting and indexing service for all science, with everything thrown together, all the information thrown together, would not be effective.

An index, for example, which covered more than chemistry, which covered biology and mechanics and astronomy and so forth, would be all cluttered up for the chemical user. An index is not an easy thing to make well. It must be made by chemists for chemists. You will find that our indexes are full of long chemical names, for example. An index must be made for each branch of science for effective results. Each branch of science should be dealt with separately. If one tried to put it all together, the operation would be awkward and the indexing couldn't be done well. It would be awkward to use.

Senator MARTIN. The creation of a central library or collection of all materials in all sciences in one spot is absolutely out of reason for the Government's activity.

Dr. CRANE. I think the Library of Congress has most of this.

Senator MARTIN. We are not contemplating here putting any restrictions on what you do in private industry along this line. I am trying to build up some idea of what the Government activity should be.

Dr. CRANE. We don't attempt to save the source publications on

which our work is based. I understand that the National Federation of Science Abstracting and Indexing Services is to be discussed by Dr. Conrad, who will appear later.

Senator LAUSCHE. I have a question on that subject. To what extent has there been an effort to coordinate the activities and create a sort of central agency out of which information could be available? You say here:

> In January of this year representatives of the larger American abstracting and indexing services, 14 of them, met in Philadelphia to consider the advisability of the formation of a cooperative organization.

Will you discuss that in a little greater detail?

Dr. CRANE. That was a group of editors of abstracting and indexing services. What the group hopes to do is to be able to help each other by an exchange of information and by perhaps pooling research work on methods. Also we hope to be able to evaluate the services for various branches of science and to be of some service possibly to the Government, possibly to philanthropic agencies, if they seek to strengthen services here and there where strengthening is needed, and perhaps to stimulate the formation of abstract journals in a few areas which are not being served.

Senator LAUSCHE. Which areas are those?

Dr. CRANE. Well, I have never made an analysis of that. I know astronomy has been spoken of as one of them. I do not know.

The question, by the way, of overlapping, has been discussed from time to time during this hearing. I would like to go on record as stating that a certain amount of overlapping is desirable and not objectionable. For example, a paper may be half chemistry and half biology. An abstract prepared from the viewpoint of the chemist would differ from an abstract prepared from the viewpoint of the biologist, and an index based on that abstract would emphasize the chemical side in a chemical abstract journal and the biological side in Biological Abstracts.

That is all right; it is desirable. The chemist should be able to use one abstracting and indexing service to cover the whole field of chemistry. The biologist should be able to do the same thing for biology.

The Russians recognize this. They have 13 abstract journals. But they repeat abstracts from one branch to another when more than one field of science is involved.

I think that I might read the last part of my statement and that will probably cover things I read from page 14. This is a summarizing statement.

I compliment the committee on recognizing the general situation which I have tried to outline. I do not know all of the answers by a long way, but I hope that out of a lifetime of work with Chemical Abstracts, I may be able to be of some help in pointing to pitfalls, in calling attention to tried and proven methods, and in emphasizing the kinds of needs. In particular, I would like once more to emphasize my belief that the active and responsible participation of scientists themselves in handling the literature of their branches of science is not secondary to the need for more financial support for primary and secondary publication if effective use of the scientific information obtained is to keep up with the present feverish scientific research activity.

May I add that some of the research activity should be expended on methods of recording and retrieving scientific information. This is worthy of governmental support. There is much interest these days in the possibility of mechanizing the recording and retrieving of scientific information. This problem has not been solved as yet for more than special and restricted areas and purposes.

Chemical Abstracts has an active research department and the American Chemical Society has budgeted more than $100,000 in 1958 for research on methods of dealing with scientific literature. Further study of the handling of scientific information by machines is highly desirable. The problem is extremely difficult. The time is not ripe to place significant dependence on such a method for broad fields of knowledge.

I would like to emphasize this last statement: Abstracts and indexes will continue to be needed when the mechanization problem is solved. Both methods will serve useful purposes.

Senator THURMOND. Mr. Crane, I want to thank you for your kind consideration here. It will be very helpful to the committee in the study it is now undertaking.

Dr. CRANE. Thank you, sir.

Senator THURMOND. Do you have any further questions?

Senator LAUSCHE. No, sir.

Senator THURMOND. Senator Martin?

Senator MARTIN. No, sir.

Senator THURMOND. We will insert in the record at this point an article entitled "Present Challenge to American Science and Technology." It is a statement of policy by the board of directors of the American Chemical Society.

Also, the summary entitled "Some of the Faults of the Abstract Journals of the Institute for Scientific and Technical Information."

(The documents referred to are as follows:)

STATEMENT OF POLICY BY THE BOARD OF DIRECTORS OF THE AMERICAN CHEMICAL SOCIETY ON THE PRESENT CHALLENGE TO AMERICAN SCIENCE AND TECHNOLOGY

Events of the past several months have made the American people aware, as never before, of the importance of science and technology to their continuing welfare and security. This awareness has prompted many proposals for accelerating scientific progress, particularly in the military field, and for strengthening our educational system to assure the training of highly qualified scientists and engineers to meet the Nation's future needs.

These are problems with which the American Chemical Society has been actively concerned for years. In World War II, for example, the society warned the Nation of the unfortunate effects on our scientific and technical manpower of certain selective-service policies, which untimately were corrected. The society has pointed repeatedly to weaknesses in the educational system, and has suggested remedies. The need for a more favorable climate for the work of scientists and engineers has constantly been stressed.

In the light of recent developments, it seems appropriate at this time for the board of directors of the society to reemphasize many of the views it has expressed previously, and to offer some additional recommendations.

With national defense increasingly dependent upon continuing technological progress, the present situation poses a twofold challenge to the United States—that of maintaining the country's immediate security, and that of doing whatever is necessary to insure its safety 10 to 30 years from now.

The immediate danger is essentially military, and must be met with the men and other resources now available. The long-range danger is far more complex, and can best be met by a comprehensive program to strengthen the American educational system.

In the military area, research and development work is of prime importance. As now organized, these activities are divided among three services—the Army,

Navy, and Air Force. Although some research and development work is applicable to only 1 service, many projects are of equal interest to 2 or all 3 services. For this reason, greater centralization of military research seems desirable. To be most effective, such a program should be under a director reporting to the Secretary of Defense and should have adequate financial support.

With respect to nonmilitary research and development activities of the Government, this board believes that a comparable situation exists and that here, too, greater centralization is in order. Those research and development programs of concern to more than one agency could well be combined under a director who would have adequate funds for his operations and who would report to the President. This director would be in a position to advise the top policy councils of the Government on scientific matters.

Research and development work is almost always done on a project basis. The very nature of research—exploration of the unknown—makes exact scheduling difficult, if not impossible. Most projects of significance cannot be finished in a year; many require several years. The system of awarding funds annually, in common use at present, often interferes with efficient operations. Therefore, this board recommends that Congress adopt as a general policy the granting of research funds on a long-range basis to cover those projects which obviously will require more than a year.

The long-range challenge to the United States requires substantial improvement of our educational system to train properly leaders in science, technology, and other vital fields whom the Nation needs in the years ahead. Much more emphasis, therefore, must be placed upon maximum intellectual development as the main goal of education.

This board recognizes the need for the education of all in a democracy, and the consequent need for a variety of courses to meet the requirements and interests of students of differing abilities. The board believes, however, that the time has come to make a clear distinction at every educational level between fundamental courses—such as the sciences, mathematics, languages, and the humanities—which contribute to intellectual growth, and courses which do not. Once this distinction has been established, scholarships, awards, and college entrance requirements should be based largely on accomplishment in fundamental courses. This will encourage superior students to concentrate on fundamentals and will help parents to judge the value of their children's studies.

Important though greater emphasis upon fundamental subjects may be, it will accomplish little if our schools and colleges lack competent teachers of those subjects. There is ample evidence of a teacher shortage which can be attributed largely to low salaries and low prestige. This situation must be corrected.

This board believes that teacher training practices should be modified in many States. Teacher certification standards should be based primarily on knowledge of subjects to be taught.

Science has moved so rapidly that curriculums, textbooks, reference materials, teaching aids, and tools of communication are often outmoded. Modernization is urgently needed to increase the effectiveness of teachers.

Elementary and secondary education in the United States is under local control, and the support of school boards, parents, and taxpayers is necessary for improvements. Many of the 151 local sections and 83,000 individual members of the American Chemical Society have worked in their own communities toward these goals. The board recommends that such efforts be continued and intensified.

It is recommended, also, that efforts to build public understanding of the work of scientists and the meaning and importance of scientific progress be increased. The press, radio, television, and all other available mediums should be used for this purpose.

Basic research is another area in which greatly increased activity is imperative. Broader support is needed for basic research in the United States to assure a proper balance with technology. Basic research seeks new knowledge of the laws of nature, regardless of immediate practical value. Technology applies basic scientific information to the solution of practical problems, including the development of new weapons. Because of intense technological competition among nations, the country which leads in basic research is most likely to lead in technology.

To sum up, the board of directors of the American Chemical Society offer the following recommendations to meet the present challenge to American science and technology:

1. Greater centralization of military research, with adequate financial support, under a director reporting to the Secretary of Defense.

2. Greater centralization of the Government's nonmilitary scientific and technological activities, with adequate financial support, under a director reporting to the President.

3. Adoption by Congress of a policy whereby research funds could be granted on a long-range basis, so that projects requiring more than one year could be planned and executed more efficiently.

4. Restoration of emphasis in school and college curriculums upon courses contributing to intellectual development through:

(*a*) Evaluation of courses on the basis of the intellectual challenge they offer;

(*b*) Recognition of achievement in the more intellectually challenging courses as the basis for college entrance and for scholarship grants and awards.

5. Improvement of incentives to attract highly qualified men and women to the teaching profession through:

(*a*) Adequate compensation, with increases based mainly on merit and on subject matter training and experience;

(*b*) Increased prestige, based on greater opportunities for self-improvement and wider public recognition of the contributions of teachers to the national welfare and security.

6. Investigation and development of more modern curriculums, textbooks, referencen materials, teaching aids, and tools of communication to improve the effectiveness of teachers.

7. Modification of teacher training practices and certification standards in many States to increase emphasis on knowledge of subjects to be taught.

8. Continued and increased efforts by local sections and individual members of the American Chemical Society to strengthen the school systems of their own communities.

9. Increased efforts, through all mediums, to build public understanding of the work of scientists and the meaning and importance of scientific progress.

10. Broader support of basic research in the United States.

SOME OF THE FAULTS OF THE ABSTRACT JOURNALS OF THE INSTITUTE FOR SCIENTIFIC INFORMATION (IENISH, E. V., SOVIET BIBLIOGRAPHY (MOSCOW) No. 43, 92, (1956)).

In 1952 a special institute of scientific information was set up one of whose main tasks was to publish abstract journals in the various branches of science and technology. The broadest possibilities were opened up for abstracting of the world's scientific literature. The concentration of this work in a single institute, the preparation of abstracts by scientists with different specialties under a single organization and the methodical guidance of the overall editing should guarantee a high quality for the Soviet abstracting journals.

The abstracting journals of the All-Union Institute for Scientific and Technical Information Gostekhniki S. S. S. R. and Akademii Nauk S. S. S. R. became an irreplaceable assistance in the bibliographic work of libraries. Readers can hardly wait for the current numbers of those series which have already been published as well as the first numbers of the new series.

In addition, the 2-year experience with the abstracting journals uncovered a number of faults which to a greater or lesser degree make the use of these publications in bibliographic work difficult. One of the first questions which comes up is how broad is the circle represented by the material in it. The editors of the abstracting journals have often emphasized their intention of covering the world's scientific literature on the exact and natural sciences and on technology with exhaustive thoroughness. However, this literature is so extensive that the editors are not as yet in a position to give abstracts and annotations of all of the articles in periodical publications, on all of the collections, books, and patents which are of scientific and practical interest. Therefore, the desire of the readers of the abstracting journals to see a list of the periodicals whose contents are abstracted regularly is understandable. Unfortunately, such a list is not available as yet. It could indicate to the specialist which of the journals, which publish material of interest to him, are covered by the Institute of Scientific and Technical Information (INTI) and which journals he must cover himself or through other bibliographic sources.

S. N. Korytnikov was correct when he wrote, in his review of the abstract journal, Astronomiya that the publication of a list of the publications covered

in the yearly series must be considered the "moral obligation of the editors of the Referat, Zhur, Astron. (R. Zh. A.) as a Soviet journal which respects the interests of its reader" (Astron. Zhur. 1954, No. 2, 211).

It is also important that the semiannual, or at least the annual, series of the abstract journal give at least a relatively complete representation of the literature for the corresponding 6 months or year, i. e., for a fixed period. At the present time it is necessary, so as not to pass over valuable scientific works, to cover additional Soviet and foreign bibliographic sources. This takes up a great deal of time, but it is impossible to avoid this since at times material is published 2 years late in the abstract journals. Thus, in the September number of the Referat, Zhur, Mekh. (1955), abstracts of articles (for example Nos. 4964 and 5205) published in Russian journals in January 1953) can be found.

In surveying the numbers of the series Khimiya and Mekhanika which have been published up to May of 1955, the reader does not encounter a single article from Zavodskaya Lab. although the major part of this journal is devoted to analytical chemistry and mechanical testing. The contents of this journal for the years 1953–54 started to be covered in the abstracting journal only after May 1955. In the series Mekhanika and Natematika for the years 1953–55, not all of the articles from the journal Priklad. Mat. i Mekh. for 1953 are covered.[1]

The untimely inclusion of articles raises doubt as to the completeness of the journal. The I. M. T. I. should organize its work in such a way that the bibliographic citation of all of the articles from the number of the periodical being abstracted would appear in 2 or 3 consecutive numbers of the corresponding series, but no later than 6 months after the publication of the article.

The abstract journals give little information about books, particularly the foreign books. In the majority of cases the foreign books are neither abstracted nor cited. Only a very small part of the foreign books get even a simple bibliographic description.

Along with the absence of any acknowledgement of a number of valuable works, descriptions are encountered of articles which have been reprinted in foreign journals from our periodicals. Among them there are many popular articles (for example, series Astron, 1955, No. 4166; Fix. 1955, No. 17872; Mekh. 1956, No. 580; Khim 1956, No. 43), articles which are not of scientific or practical value (series Khim. 1954, No. 10047) and also articles which have only an indirect relation to the subject matter of the given series (series Khim. 1956, Nos. 1380, 1394).

The number of series of the abstracting journals is continuously increasing. The close relationship between the sciences to which the individual series are devoted requires the correct distribution of the material among them and the clear cut systematizing of the literature within each of them. It is also necessary to insure a certain uniformity in the different series by solving the methodological questions.

It is not the aim of this review to analyze the systematizing of the literature in the individual series. Specialists in the corresponding fields should decide this question.[2]

The I. N. T. I. is striving to cover in each abstract journal all of the literature which has even a indirect relation to the subject matter of the given series. This has a known advantage, but at the same time it leads, in a number of cases, to the occasional selection of articles on a subject which is more fully covered in another series or to which a special series should be devoted.

Thus, for example, in the series Fiz. the section Elektrichestvo (Electricity) has the heading "Poluprovodniki" (semiconductors), the section Elektronika (Electronics) has the heading "Poluprovodnikovye ustroistva i fotollementy" (semiconducting apparatuses and photoelements). In addition, in the series Mat. the section Vychislitel'nye mashiny i matematicheskie pribory (calculating machines and mathematical apparatuses) includes abstracts and citations for articles of a general nature on the production of germanium, on semiconducting triodes, transistors, diodes, etc. Individual articles on the technology of the production of printing set ups and even on the production of radio parts. However, only a small amount of all of the literature on semiconducting circuits, their development and preparation. Since it would hardly be possible to collect all of the literature on the given subject in this large section, it would be better to give only those works which deal specifically with the use of semiconductors in calculating apparatuses.

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[1] For example, the following articles were not covered (lists 4 references which I have not included here JRL).

[2] A significant amount of space has been given to the question of the systematizing of the literature in the following reviews: (4 references given which I have not included).

In order to avoid duplication, it would be more reasonable to introduce in certain sections, references from one series to the other.

In the abstracting journals, at times the literature on one subject is scattered throughout several of the series and within the series throughout a number of sections. In such cases, it is only sometimes duplicated or referred to, for example, in the series Astron. In the section Problem of the Sun-Earth and the work of the sun, solar radiation, the literature on the apparatuses for utilizing solar energy is covered. Abstracts of the articles on the use of solar energy are also entered in the Fiz. series under the heading of "The Use of Solar Energy," in the section on Geophysics as well as in the sections on Heat and Optics. In those numbers of the Fiz. series which contain the heading "Use of Solar Energy" there are references to articles on the same subject which appear in other sections. However, in Fiz. series No. 3 (1955) this heading does not appear, but in the section on Heat there is an abstract of an article on the recent advances in the field of solar furnaces for use in science and technology (No. 4555).

If it is added that only part of the works on heliotechnology appear simultaneously in the Fiz. and Astron.[3] series then one can readily see how difficult it is to find this literature.

The use of the abstracting journals is further complicated by the fact that at times the headings are not clearly formulated, their names do not correspond to their contents, the scheme of classification is not completely enough expressed in the index of a number of series. Thus, for example, the contents of the section "Problem of the sun—earth, and work of the sun—solar radiation" hardly corresponds fully with its name. In this section, along with abstracts of articles on the study of sunspots and records of solar activity, abstracts appear of technological articles on the design of solar furnaces, on the construction of solar distillation apparatus, etc.

In the "Mat" series a subheading appears in the section "Calculating machines and mathematical apparatuses" entitled "The Use of Calculating Apparatuses and Their Elements in Technology." It can be shown that its title discourages the reader from checking this subheading in searching the literature on the use of calculating techniques in astronomy or medicine. On the other hand, literature searches on the use of mathematical machines in technology should be sufficient by limiting the search to just this section. In truth, however, articles can be found in it on the automatic measurements and recording of positions of stars, on the electronic apparatus for blood analysis, and even on the use of calculating machines by the police of the United States of America for treating materials on criminal records ("Mat" series, 1955, Nos. 1048, 1577, 4122, 6304). At the same time a significant number of articles on the use of mathematical machines and apparatuses in technology are covered only in the general part of the section "Calculators and mathematical apparatuses" without any references to it in the subheading "The Use of Calculators and Their Elements in Technology," for example.

In the series Fiz. and Geol-Geog, the indexes do not include a number of five divisions in the classification scheme which are quite important for literature searches on specific questions. In the Fiz. series, for example, only the name of the section "Nuclear technology and energy" is given in the index. The subheadings "General Questions," "Nuclear Reactors and the Production of Nuclear Energy," "Atomic Weapons," "Different Uses for Radioactive Isotopes" are not indicated in the index.

Certain sections which are large in volume do not have more defined subsections. Thus, in No. 13 of the Khimiya series (1955) the section on "Synthetic organic chemistry" takes up 89 pages and in No. 19, 77 pages. This makes literature searching more difficult.

Frequent changes in the individual divisions of the (classification) scheme, in their placement and in their contents are very confusing. Thus, in Fiz. No. 11 (1954) the heading "High Temperatures" comes first. In No. 2 (1955) the heading "Thermometry, High Temperatures" appears. In No. 3 (1955) the new heading "Temperature Scales, Thermometry" is introduced and the articles on high temperatures are placed in the subsection "Thermal conductivity, heat exchange."

(Omitted one paragraph p. 95. Further illustrations of point just made.)

Within the sections of the individual series the materials, which are uniform in their form of publication (articles, books, etc.) are arranged in order of the value of the subject matter which is very arbitrary and sometimes even disputable. It

[3] Thus, for example, the citation to the book of B. V. Petukhov, Apparatus for the Solar Heating of Water, is found in the Astron. series (1954, No. 3, No. 2734), but it is not present in the Fiz. series, but the article by G. Vinaccia, Absorbers and Accumulators of Solar Energy, is in Fiz. (1954, No. 11, No. 14021), but not in the Astron. series.

would be more suitable to set up a number of fine subheadings within each section. This would make finding the materials on specific questions significantly easier. Within each section the scheme should be to group the domestic and the foreign literature separately since the abstract journals are used mainly to get information on foreign literature. The specialists can usually get the information on the domestic literature from more operative bibliographic sources.

The development of sufficiently refined and stable classification schemes, in which the contents of the subsections would correspond to their titles, the complete coverage of the scheme in the index, a wide use of references, order in the distribution of the material within the sections, these would all make finding the literature in the abstract journals easier. It is now possible to find interesting material on almost any subject in them, but it requires the complete coverage of many sections in several series.

The quality of the abstracts is of major importance. In the reviews cited above, specialists in the various fields have all suggested the further improvement of the abstracting methods, a shortening of the too-detailed abstracts, and avoiding the abstracting of second-class material. The only difference of opinion was on the inclusion of abstracts of critical remarks. In our opinion, the presence of (critical) evaluations in abstracts which are written by qualified specialists can only be helpful. It is of course, understood that critical remarks are only necessary as required by the material being abstracted. They should not be placed within the body of the text but as a note to it as is usually done.

We concern with the statement of one of the reviewers opposing the use of phrases such as in the author's opinion and according to the author's opinion. In themselves they do not contain any evaluation of the work and only serve to cast some doubt as to the value of the material abstracted.

The I.N.T.I. has rejected the rules of bibliographies description which are generally accepted in the Soviet Union, following the majority of the English and American abstract publications in which the title of the article and not the author is cited first. The institute feels that in this way the titles stand out more and make the search for the necessary articles more simple.

This deviation is disputable in several respects. First of all, the titles can be emphasized by the use of proper print even if they followed the author's name.

Secondly, specialists in a given field recognize the names of those who work in the field. It is important to him to find these names quickly by scanning the journal. These names when placed after a lengthly title, and often printed without initials, can easily escape the reader's attention. (This point is elaborated and references to journals given.)

In the third place, it is well known that in foreign periodicals, particularly technical publications, the title of an article has little to do with its contents (references to illustrate this point).

Finally the breakdown in the usually accepted rules of description corresponds to the development of arbitrariness in the bibliographic formulation of references to scientific works. The negative consequences of this arbitrariness in the bibliographic formulation of references to scientific works. The negative consequences of this arbitrariness is already well known to librarians and to readers who, at times, cannot make use of interesting material because of the form of the reference.

(Omitted p. 97, illustrations of objection above.)

It must be pointed out that there is some degree of disorder in the bibliographic descriptions in the abstract journals. Thus, in the first members of the Mekh series the number of pages was often omitted from the book references. The order of the descriptive elements, e. g., the price and publication date, was often changed within a single journal. Now the order has become somewhat more stable. In the future more work should be done on unifying the references and in making them coincide more nearly to that used for all of the Soviet bibliographical publications.

It is also necessary to establish some uniformity in the abbreviations which are used in the journal names since, at times, these abbreviations make finding the original publication difficult. Thus in Mekh 1955, No. 5876, the title of a German journal has been abbreviated to two letters "TM" which to the present time remains a mystery to us.

In the abstract journals only 55 to 60 percent of the articles given in each number are accompanied by abstracts. The rest only have a bibliographic description and at times a brief annotation. This agrees on the whole with the purpose of the journals of the I.N.T.I. since a detailed abstracting of all of the literature would be undesirable. Only the most important or the less available articles should be abstracted.

Annotations are also encountered which are merely rewording of material which does not require additional description. (Illustration of detailed abstract on history of aviation.)

Sometimes articles are cited without any annotation whose contents can only be guessed from the title (illustration). This article was published in a Geneva publication Interavia which is rarely available in Russian libraries. It is doubtful that any of the Soviet readers can make use of such information.

It is unfortunate that articles from such languages as Japanese and Chinese which are not known to the majority of the specialists are only rarely abstracted nor are they always annotated.

(Careful bibliographic editing of the abstracting journals must be insured in order to avoid the errors described above. This is a condensation of a long list of the errors described above JRL.)

For a comprehensive coverage of the literature, particularly in the Fiz and Khimiya series, the publication of an index is a necessity. Unfortunately the subject index is published after a significant delay. For example, the subject index for the Mekh series 1953–54 was published in February 1956.

A rapid scanning of this index shows that its compilers ignored a number of important rules of indexing and did not learn the necessity of having a logical relation between the headings and the subheadings (illustrations).

There are many obvious errors in the index (illustration). The editors must give serious attention to the development of a high-quality subject index which is the most important key to the great quantity of material which is included in this journal.

The publication of an author index has also been late although its compilation is much simpler than the subject index. One of the reasons for its delay is its unusually big size. All of the names, which are given in the original Latin alphabet, are repeated four times; in the main author index they are given in the Russian alphabet with an indication of the original printing and in the auxiliary author index they are given in the original print with an indication of the Russian transliteration. It would be sufficient to give the Russian transliteration only in those cases in which the original is in an alphabet which is not known to the majority of the readers, e. g., Georgian, Armenian, etc.

The division of the author index into the main section in which the title of the article is given after the Russian transliteration of the author name, and the auxiliary section in which the Russian transliteration and the number of the abstract follows the author name given in its original form only makes finding given works of specific authors more difficult since it is necessary to go from the name in the original alphabet to the main section to find the title.

The difficulty of finding the works of foreign authors with common names is further complicated by the fact that in the main section, the surname in the Russian transliteration is not accompanied with initials (illustrates with Smiths which take up 12 columns in index for Khimiya 1953–54).

It is natural that the publication of the I.N.T.I., which have only recently been started, should be subjected to numerous growing pains. An extensive discussion of the abstract journals in our news should insure an increase in the quality of these very necessary journals.

E. V. IENISH.[4]

Senator THURMOND. Dr. Taube, we are glad to have you with us. You may proceed.

If you wish to read your statement, you may do so, or if you wish for us to put that in the record and then let you talk off the cuff, you may proceed in that way.

STATEMENT OF MORTIMER TAUBE, PRESIDENT, DOCUMENTATION, INC., WASHINGTON, D. C.

Mr. TAUBE. I would like to talk from it. I would like your indulgence to say something about myself first, to establish my competence in this field, because essentially the view I am going to present is different from many of the views that you have heard.

[4] Candidate Pedagod, Sciences, Chief of the Group of the Technical Information Bibliographic Department of the State Public Library named for M. E. Saltykov-Shchedrin.

There is a biographical statement in Who's Who which I hope you can place in the record, and I won't repeat many of those details.

Senator THURMOND. We will place that in the record and will save time.

(The statement referred to is as follows:)

MORTIMER TAUBE [1]

Taube, Mortimer, documentalist; b. Jersey City, Dec. 6, 1910; s. Solomon and Bertha (Solosko) T.; student Rutgers U., 1927–30; A. B., U. Chgo., 1931; student Harvard, 1931–32; Ph. D., U. Cal., 1935, certificate sch. librarianship, 1936; m. Bernice Schwartzman, Mar 23, 1939; children—Susan Rose, Donald, Deborah. Teaching fellow philosophy U. Cal., 1932–35; circulation librarian Mills Coll., 1936–37; cataloger Rutgers U. Library, 1938–40; head acquisitions dept. Duke U. Library, 1940–44; asst. chief, gen. ref. and bibliography div. Library Congress, 1944–45, asst. dir. acquisitions dept. 1945–47, head mission to Europe, 1946, chef. sci. and tech. project, 1947–49, cons. sci. documentation since 1949. Rep. research and development bd. Dept. Def., Royal Soc. Sci. Information Meeting, 1948; dep. chief. tech. information service AEC, 1949–52; mem. surgeon gen. com. med. indexing 1949–52; Am. mem. internat. expert com. bibliography UNESCO since 1950; pres. Documentation, Inc., Washington, since 1952; lectr. grad. library sch. U. Chgo., 1952; lectr. grad. scho. Dept. Agr., 1952; asso. in library service Columbia, 1952. Recipient award for contbn. library profession, Spl. Libraries Assn., 1952. Mem. Am. Standards Assn. (mem.-at-large com. library, documentation standards). Am. Documentation Inst. (chmn. com. tng. and edn.), Spl. Libraries Assn., A. L. A., Phi Beta Kappa. Author: Causation, Freedom and Determinism, 1936; Manual for Bibliographers in Library of Congress (with Helen Conover), 1944. Editor: American Documentation, 1951–52; Studies in Coordinate Indexing, Vol. I, 1953; Vol. II, 1954. Contbr. articles profl. publs. Home: 6820 Meadow Lane, Chevy Chase 15, Md. Office: 2521 Connecticut Av., Washington 8.

Mr. TAUBE. I received the first and only professional award ever given by a national society—the Special Libraries Association of the 5,000 libraries you have heard about—for pioneering in documentation.

I developed and taught the first course in documentation given by an American university.

I conceived, planned, and organized the science and technology project at the Library of Congress, and participated in the development of the Technical Information Service of the Atomic Energy Commission. These two operations are universally recognized as being among the most successful Government enterprises in the field of scientific information.

I designed the method of cataloging, which is known colloquially as the side-margin card, which is now standard for Government scientific reports.

The Government is already financing a large part of the Nation's scientific information activities. It is financing research in new methods, including mechanization; the Government is also financing publication, indexing, abstracting, pilot projects, information centers, and translations.

This makes me think that the question before the committee is: Should there be just more of the same, more money for the present uncoordinated activities which are universally recognized to be inadequate? Or should there be a planned coordinated attack on this problem?

Statements have been given to the committee in writing and you have heard statements to the effect that the Government always

[1] Source: Who's Who in America, 1958–59. Chicago, A. N. Marquis Co., 1958, p. 2727.

fails in this field as contrasted with the presumed success of private agencies. What are the facts? I have listed a number of these, and I think we can go through some of them:

With the moral support and approval of the American Medical Association, the Government has undertaken responsibility for indexing medical literature.

The Government issues the Bibliography of Agriculture, the major bibliographical tool in this field.

The Government publishes Nuclear Science Abstracts and the major indexes and to the literature in this field.

The Government finances the preparation and publication of Applied Mechanics Reviews.

The Government finances the preparation and publication of Mathematical Reviews.

The basic research material in aeronautics is published, distributed, and indexed by the Government.

The Government prepares, publishes, and distributes European Scientific Notes, a digest of scientific meetings and important scientific developments abroad.

The Government has financed numerous information centers and services in special fields; for example, infrared, titanium, Arctic regions, solid propellants, aircraft instrumentation, and so forth.

The Government planned and issued the major compilations of scientific data from World War II, the summary technical reports of NDRC, the Radiation Laboratory series and the national nuclear energy series. Parenthetically, it might be added, that it was not always easy to secure the cooperation of independent scientists and universities in this endeavor.

Agencies of the Government have conducted and/or supported most of the research looking toward mechanization of information retrieval.

The Government has financed almost all the work in mechanical translation and almost all the actual translation of Russian scientific and technical material.

In the field of standard library activities, the card distribution system of the Library of Congress constitutes the Nation's major bibliographical tool.

The Government has taken over responsibility for the union list of serials, a project which outgrew the resources of private agencies.

Biological Abstracts, which are privately published, require Government support in order to survive and is admittedly providing only partial coverage of the important literature.

No physics abstracting service is published in this country. The Government financed a study of this problem but had no voice in the decision to remain dependent on a British service.

Finally, there is Chemical Abstracts, which has so far preferred industrial to Government subsidy. I understand that they have solved their present deficit by a new pricing policy. This was the pricing policy that Dr. Crane mentioned, namely, charging industry $350 as opposed to individuals whom they charged $20. But Chemical Abstracts today faces a heartbreaking task in its effort to maintain currency and completeness.

During the course of this hearing you have heard much of Chemical Abstracts. It is a great bibliographical achievement. However, in

terms of some of the questions that Senator Martin raised about the relationship of Government to private activities, the existence of Chemical Abstracts as a private service obscures, I think, the true situation. We should not allow the existence of Chemical Abstracts and the existence of a host of imitators which never attained its stature, to block our pathways to the future.

This list is by no means complete; but it indicates that the basic problem is not competition between Government and private agencies, but whether or not the Government intends to put its own house in order—to get value received for the millions of dollars it is already spending and will continue to spend in this area.

There is an obvious, undeniable requirement for a Government agency with authority and responsibility for an effective national scientific and technical information program. The important points here—in terms of the questions which have been asked by the committee—are authority and responsibility and not what part of the total program the agency operates itself, and how much it subsidizes, supports, supplements or complements existing governmental and private activities already operative in this field.

Whether this authority should be assigned to an existing agency or to a new agency setup, I think, is a matter about which there is still uncertainty. I think it is a decision which must await testimony before this committee by interested agencies and the type of study we have earlier proposed to this committee, which was made a part of its initial staff report.

It has been stated before this committee that there has been too much study and deliberation and no action. The fact is that our problem now arises from too much uncoordinated, unplanned action and not enough deliberate study and planning.

There may be serious administrative questions which would make it inopportune to inaugurate either the general or special purposes of S. 3126; but the supposed fear of Government domination of science is not a valid difficulty.

Governments have been in science since the dawn of the modern scientific era. When the universities of the 16th and 17th centuries proved too hidebound to provide a hospitable atmosphere for the vigorous new science of the period, the rising national governments founded academies and scientific societies—scientific journals and proceedings to carry out the tasks the universities could not or would not perform.

New times and new problems create the need for new instruments, new administrative forms; and even require a certain ruthlessness vis-a-vis the sacred cows of the past. I point out that the Government created the National Academy of Sciences during the War Between the States; it created the National Research Council in World War I; it created the National Defense Research Committee and Office of Scientific Research and Development in World War II. After the war it created the Office of Technical Services, the Office of Naval Research, the Atomic Energy Commission, and the National Science Foundation. All of these in some way are efforts to coordinate a program without specific responsibility to any one organization to do the job.

Whether the times now call for a science department or a central scientific information office, are questions which must be decided on

their merits—they should not be complicated by pious non sequiturs about the noble scientist who just wants to be let alone, with enough money to carry on his work, or pious fears concerning the subordination of the scientist to the politician.

I have never been able to understand why the trustees of a university or the directors of a corporation have a right and duty to make policy in the field of science which is denied to the Congress of the United States. The individual scientist in this situation is just like any other individual; he fears and respects his boss, and takes out his frustrations on his elected representatives.

I would conclude, gentlemen, by saying that any recommendation I could give you, would be in two parts.

One, that there should be established a Government agency with definite responsibility for a national scientific information program. The Government cannot give away its responsibility in this area any more than it can give up its responsibility for manpower; any more than it could contract out the Civil Service Commission.

What we have recognized now is that information is a major resource of a modern industrial nation. Once we have recognized this fact, then we must provide a proper information program by the Federal Government. Once this authority and responsibility is recognized, how exactly it is implemented, how much existing agencies are used, how much is done by new agencies, is something that the agency with responsibility must determine. Congress must decide that this is our national policy.

Thank you.

Senator THURMOND. Are there any questions, Senator Lausche?

Senator LAUSCHE. Have you yourself given any thought to existing agencies into which this type of service which you have in mind might fit?

Mr. TAUBE. There are a number of agencies that have partial responsibility in this field, Senator. The Office of Technical Services in the Department of Commerce has a partial responsibility, but it doesn't have authority. What information it gets, it gets only if the other Government agencies give it to it.

After the war, by Executive order, a publication board was established, which was supposed to see to the declassification of Government documents, and captured material. The Office of Technical Services was set up to make this available. But it had no authority to compel the military to declassify, to give it the material. Even today they have to beg for material from other agencies in order to distribute it. They have no authority to get it.

The National Science Foundation, as I understand it—and by the way, I am not really a student of government, I am a student of documentation—is a policy agency, and not an operating agency. Whether this could be changed, whether it could become the responsible agency, I don't know.

Senator LAUSCHE. Your thought now is that an agency ought to be created vested with authority and responsibility to coordinate activities?

Mr. TAUBE. To do what was required.

Senator LAUSCHE. And subsequently the detailed operations which it might engage in could be ascertained by that agency?

Mr. TAUBE. By that agency itself. This is the way our Government operates now. We allow the agency, once Congress determines the policy, to determine how much it shall do by itself, what it shall contract for, what it shall set up committees to do, and so on. I think this problem is a matter which must be left to the executive agency once it has the authority and the responsibility.

Senator LAUSCHE. That is all that I have, Senator.

Senator THURMOND. Senator Martin, do you have any questions?

Senator MARTIN. The plan you visualize here does not call for duplication of all the libraries in any sense of the word?

Mr. TAUBE. No; it does not.

Senator MARTIN. It is merely the management end of the program?

Mr. TAUBE. Right.

Senator MARTIN. The clearinghouse approach?

Mr. Taube. Right.

Senator MARTIN. Without the indexing and the cataloging and the familiarizing of the field with the availability of the information, all of which presumably will be left in private hands where it now rests?

Mr. TAUBE. Yes.

Senator MARTIN. Would it be more proper for the consideration of this committee to move just as far as that, to set up a commission of some kind to make a survey and study on this, so that we will have a little better idea of what we are taking before Congress?

Mr. TAUBE. This is a difficult problem. The point about a commission is that you will have difficulty getting good professionals to work on it, especially if it is a temporary organization. You will have to draw your people from executive agencies; there may be conflicts of interests among these people. This is the problem that you face with a study before the decision.

I know we have a "chicken and egg" situation here, Senator. But if Congress once made this policy decision it could then get a professional staff that would determine what would be the operations which it should do, which it should coordinate, which it should farm out, which it should contract for, and so on.

Senator MARTIN. I have long since learned the policy of surveying the situation before taking final recommendations before Congress. When we go before Congress with a program we should be able to deliniate the program rather carefully, and understandably.

Mr. TAUBE. I understand.

Senator MARTIN. That rule is a pretty good rule for us to follow on this committee. I would not want to recommend a final program on my present meager knowledge of the field we are trying to cover. It will take me a while to prepare myself. I thought we might have the assistance of a commission who know better what the subject is.

Mr. TAUBE. I certainly think you could get it. We did recommend a study as a first step.

Senator MARTIN. If you are looking to this committee to come out with a final recommendation, and take it out on the floor of the Senate and discuss it satisfactorily, you will have quite a wait for me to get ready.

Mr. REYNOLDS. Mr. Chairman, may I interject there?

Tommorrow we will have representatives of the National Academy of Science testify and give us some ideas about that. Then, after the agencies engaged in this type of activity have had an opportunity to

study the testimony developed in the first phase of the hearings they will be called in in 2 or 3 weeks to complete it. At that time we hope to get some definite suggestions and recommendations. I believe they will help the committee to solve some of these problems.

Senator MARTIN. On the procedure of this committee?

Mr. REYNOLDS. That is right. After they have analyzed what the independent agencies and private abstracting and scientific information groups who are operating in these various fields have indicated what they think should be done, then they will be in a better position to evaluate it and to give the committee the benefit of their recommendations.

Senator MARTIN. That will be a very good addition to our proceedings.

Senator LAUSCHE. Mr. Taube, you are familiar with the fact that this bill contains provisions other than coordinating scientific information?

Mr. TAUBE. Yes; I am. You mean it calls for a science department?

Senator LAUSCHE. As title 2, we have National Institutes of Scientific Research. Have you given any consideration to that study?

Mr. TAUBE. Yes; I have.

Senator LAUSCHE. About the establishment of a National Institute of Scientific Research to be operated by the Federal Government?

Mr. TAUBE. I have.

Senator LAUSCHE. What is your opinion of it?

Mr. TAUBE. I believe that, as I tried to say, that the Government will be in science more and more. We will find new instrumentalities, and I believe this will be one. I believe the general fear of Government in science is an unhistorical and unwise fear. It is like the fear of the Government in commerce, or the fear of the Government in labor. Science is a major part of modern industrialized life. And I certainly feel that scientific research and dissemination of information is just as much a part of a governmental function as any other activity that it might undertake. I am strong for a science department, with what ever else would be implied.

Senator LAUSCHE. You are strong for a science department. We are talking about getting bibliographies that will be adequate to help all science.

No. 2, of the department engaging in research itself, you are in favor of that?

Mr. TAUBE. I am.

Senator LAUSCHE. What about this scholarship fund of $40 million for fiscal year 1959, $60 million for fiscal year 1960, $80 million for fiscal year 1961, and $100 million for each of the fiscal years 1962, 1963, and 1964, to be given to individual States with the authority to loan the money to prospective students of science. Have you heard about that?

Mr. TAUBE. I have.

Senator LAUSCHE. What is your view on that?

Mr. TAUBE. I don't know too much about the loan program, Senator.

Senator LAUSCHE. You don't want to express an opinion?

Mr. TAUBE. I have a daughter who would like one of these scholarships. Other than that, I don't know.

Senator THURMOND. Do you think it ought to be given to students who are not able to pay their way?

Mr. TAUBE. I am not sure. This is a problem that I am not an expert in.

Mr. REYNOLDS. Mr. Chairman, I might say that this committee has more or less deferred to the Committee on Labor and Public Welfare as regards the provisions of that particular title, since they have a much broader program relating to scholarship grants and educational loans. This is only one aspect of it, which relates only to science, which was included as an essential phase of the proposed Science and Technology Act.

Senator THURMOND. That question is being considered?

Mr. REYNOLDS. Yes, sir.

Senator LAUSCHE. We have deferred to the other committee on the subject.

Mr. REYNOLDS. Under consideration at this time, Senator, is the question of documentation and the provisions of S. 1326 relating to a program in the field of documentation and making available science information to those who are in need of it. Of course, this committee may later go into those aspects after the Committee on Space and Astronautics has considered the bill and has submitted its recommendations to the Senate. At this time the bill is pending before that committee.

Senator LAUSCHE. Which committee is going to act upon this?

Mr. REYNOLDS. Labor and Public Welfare is supposed to act on scholarships and possibly upon the institute provisions. The Committee on Space and Astronautics already has under consideration title I and the other title proposed in the substitute bill (title II) which proposes the creation of standing committees on science and technology.

Mr. TAUBE. On the matter of congressional committees on science and technology, I think such committees should have the best professional staffs they can get.

Senator THURMOND. I wish to thank you, Dr. Taube, for the contribution you have made to this committee by testifying here.

The subcommittee will recess until 10 o'clock tomorrow morning in room 357.

(Thereupon, at 12:59 p. m., the subcommittee was adjourned, to reconvene at 10 a. m., Wednesday, May 7, 1958.)

SCIENCE AND TECHNOLOGY ACT OF 1958

WEDNESDAY, MAY 7, 1958

UNITED STATES SENATE,
SUBCOMMITTEE ON REORGANIZATION OF THE
COMMITTEE ON GOVERNMENT OPERATIONS,
Washington, D. C.

The subcommittee met, pursuant to adjournment, at 10:20 a. m., in room 212, Senate Office Building, Senator Hubert H. Humphrey (chairman of the subcommittee) presiding.

Present: Senators Humphrey (presiding), Thurmond, Lausche, and Martin of Iowa.

Also present: Walter L. Reynolds, chief clerk and staff director; Ann M. Grickis, assistant chief clerk; and W. E. O'Brien, professional staff member.

Senator HUMPHREY. The first witness this morning is Dr. Elmer Hutchisson, director, American Institute of Physics, New York City.

Prior to your testimony, Dr. Hutchisson, I should like to introduce into the record the letter received from the Associated Technical Services, Inc., Mr. Leon Jacolev, technical director.

Mr. Edward J. Lowy, of New York City, has sent us a statement which will also be incorporated in the hearings. He is a research consultant and president of the Kem Laboratories.

We have an additional statement from Mr. Kent, Western Reserve University, containing the material I personally requested on behalf of the subcommittee on the needs of centralized information services, a report to the National Science Foundation, which will be made a part of our testimony.

(The documents referred to are as follows:)

ASSOCIATED TECHNICAL SERVICES, INC.,
East Orange, N. J., May 6, 1958.

WALTER C. REYNOLDS,
Staff Director, Government Committee on Operations,
Washington, D. C.

DEAR MR. REYNOLDS: Your recent letter regarding the scheduled meetings before your committee relative to S. 3126 has found me in the midst of urgent business matters, which, much to my regret, make it impossible for me to appear before the committee in person. Consequently I am taking this opportunity to express my views relative to some phases of the proposed legislation.

It is my opinion that the committee should proceed with extreme caution in laying its plans for any all-inclusive superagency for the assimilation and dissemination of scientific information, including translating, abstracting, indexing, and many other ancillary activities. To create and entrust any agency with such a sweeping responsibility as "establishment of a complete science information program" [1] would not necessarily improve the present situation, in fact, it would probably conflict with the healthy growth of existing agencies. I agree wholeheartedly with Dr. E. J. Crane, editor of Chemical Abstracts Service, who stated: "it would be totally unrealistic to try to build a general science information service which would operate as a whole both in the building and in the use.

[1] Cf. page 6 of S. Doc. No. 90, Science and Technology Act of 1958.

There is need for a service to chemistry restricted to chemistry, for a service to physics restricted to physics, for a service to biology restricted to biology * * *"[1]. I also agree with Dr. Crane's view expressed in his letter to your committee that strengthening of the existing service seems to be the economical and effective procedure. In fact, in the case of chemistry, there exists such an excellent abstracting and information dissemination service, that covers the field of chemistry in the entire world, that Dr. Crane, in the same letter, states categorically that the chemists neither seek nor need help. Dr. Crane's statement should be carefully considered as he speaks on the basis of many years of experience and profound knowledge of the subject, as well as a representative of the world's largest scientific society with membership close to 85,000.

There are in existence today literally hundreds of documentation centers, abstracting services, information processing organizations, translation facilities, etc., all of which serve the specialized needs of the various branches of science and technology. The existing institutions have the experience and staffs to carry out their work most effectively and economically. It would seem to me that the Government should not inaugurate any activity that would interfere or conflict with the existing organizations. However, if an agency were set up that would be handling "a complete science information program", then even with best intentions in mind, conflicts, interferences, and entanglements of all sorts would inevitably result, all to the detriment of the very laudable objective of facilitating the dissemination of world-wide information.

Now, commenting specifically on the plans for translation and abstracting of foreign scientific information, I believe that the Government should not engage in the wholesale translation of generally available scientific information. Such an activity, and it is already going on at the present time to an appreciable extent, carried out directly or indirectly, is in competition with the existing agencies. By spending large sums of money and then either giving away the translations or selling them at below cost figures, would jeopardize the existing agencies by creating the impossible situation where translations would be available for a pittance from the Government, while realistic prices would have to be charged by self-supporting private agencies. Of course, the low prices would be fictitious, as actually the cost would be as high and even higher in the case of Government-prepared or sponsored translations, but the cost, instead of being charged to the actual user, would be coming out of every taxpayer in the country. Translations, abstracting, and other information activities are an integral part of research costs and it it difficult to see why the general public must pay these costs or subsidize them. Translations of generally available scientific information should not be the realm of Government activity, as agencies exist today that can handle these problems and, if anything, there should be only greater cooperation between these agencies and the coordination of their efforts. Of course, translations of classified material should be handled in the way that the responsible heads of our Government see fit, and this information, when and if subject to eventual declassification, could and should be made available to all interested scientists. There are indications, however, that at the present time the Government translates vast quantities of material that is not classified but generally available and that, in effect, constitutes direct competition with the existing facilities.

There is an additional problem created by these expanded Government translation programs in that the already very short supply of competent translators is being decimated by absorption of the translators into these Government projects. Private agencies are losing their competent people to these projects as not infrequently it is much easier for them to work for these Government agencies and produce many more words per unit of time, because the technical requirements not infrequently, are much less stringent than those of the better private agencies. In this connection I should like to state that the prevailing rate of $4 per 1,000 words paid to the translators, as reported on page 33 of the Senate Document No. 90, is unheard of in the industry. If you check with the Government agencies that now deal with translators and translations, you will find that they pay many times over that figure per 1,000 words and this, of course, is also true of private agencies.

Also, it seems incredible that there is a "serious employment problem for many able and qualified translators", as stated on page 33 of said document because of translation work done by foreign translators abroad at lower rates than the prevailing rates in this country. I also never heard of any translator abroad working at a rate lower than $4 per 1,000 words mentioned above. In fact, the short-

[1] Cf. page 28, ibid.

age of competent translators is so acute that we must spend months advertising in scientific journals to find technically competent men who have both the required scientific background and linguistic fluency. Any expansion in Government plans for translation agencies would make this problem even more acute, in fact, insurmountable, and lead to continuing degradation of the quality of translations.

I reiterate that the Government should not engage in the translation of generally available foreign publications but restrict its activities to classified material. The translation of generally available foreign information should be carried out by existing nongovernmental agencies and, if need be, with some financial support from interested Federal agencies. Actually since translations and abstracts are part of the research expense, they should and can be paid for in the same manner as all other research expenses are paid for, without being singled out for partial Federal subsidy or outright full payment.

There are, however, areas where Governmental agencies could perform a real service in the field of scientific information assimilation and dissemination that could not be effectively done by private agencies. These services could be implemented at nominal cost and by existing Government agencies without creating any new ones.

(1) At the present time this country does not have a complete file of Russian patents. This represents a wealth of information that reflects the technological progress of a country over the entire spectrum of technical activity. It is my understanding that quite some time ago an offer was made by the Soviet Government to exchange Soviet patents with ours. This would give us information that is unobtainable today. Unfortunately no action has been taken on this proposal for years and we are still without Soviet patents. Of course, this does not in any way preclude the other side from having our patent literature as it is generally and readily available. Consequently it is difficult to understand why we should not only act on such a proposal of patent exchange, but actually seek an opportunity whereby we could secure this wealth of information. I would suggest that this matter be looked into and suitable procedures be worked out for obtaining all existing Russian (Soviet) patents and then maintaining this file through continuous additions. These patents should be also indexed in such existing publications as the Library of Congress Monthly Index of Russian Accessions, so that this knowledge would be generally available. Anyone desiring copies of said patents should be able to secure same through the Library of Congress photoduplication services or the United States Patent Office.

(2) Governmental agencies should make full use of the existing facilities for indexing and publicizing existing translations. At the present time the John Crerar Library in Chicago publishes monthly bulletins of available translations that are indexed by subject and author. Same agency now publishes index cards for all of these translations that may be purchased by any interested party. If the Government cooperates with this project and supports it, if necessary, then there is absolutely no excuse for duplication of translations.

Translation-generating agencies, both in this country and abroad, send in their listings to the Crerar Library and thus make the translations available to the interested public through photocopies or direct sales from translation agencies. It would seem unnecessary to set up another governmental agency for indexing translations when an agency for this purpose actually exists. It would seem logical and desirable to cooperate with the existing agency and expand and improve its services, if necessary, by Government financial support.

(3) It would be desirable if the Government would develop means for securing hard-to-get foreign information, particularly Russian, and also make this information available to the interested scientists and engineers. At the present time, purchase of Russian monographic literature is a very uncertain proposition as for various and sundry reasons one cannot always obtain books, monographs, transactions, pamphlets, etc., dealing with various technical subjects. It would be desirable if the Government, through its prestige and good offices, could make arrangements for the procurement of such publications and then sell same, possibly through the Superintendent of Documents, to the interested public. Most of the Russian books are very inexpensive and a program such as this could be self-supporting.

In this connection it would be also desirable if the Government would expand and improve its exchange program with the Soviet Union and other countries in obtaining scientific information.

(4) Since all of the incoming Russian published material passes through the hands of the United States customs, it would be most desirable if steps were taken to see to it that no delays would result because of this inspection. In the past

there have been instances where Russian scientific journals have been held in our post offices for many months, thus delaying the availability of scientific information to the American scientists.

(5) The Government could also be of assistance in the overall correlation of scientific information activities. Specifically activities could be set up to see to it that foreign scientific information is made available through abstracts. As stated previously, there exist today hundreds of abstracting organizations and most of the technically valuable material is abstracted, particularly in such areas as physics, chemistry, and the biosciences. In the case of foreign information that is not currently abstracted, attention could be given to these areas and appropriate steps taken. As a rule, the primary reason for lack of abstracts is not the nonexistence of a suitable abstracting agency, but rather the inability of the existing agencies to secure the information in question. It is in the area of procurement of foreign information that the governmental activity could be of greatest value.

In this connection I should like to state that wholesale translation of foreign scientific periodicals in their entirety is not the best way of keeping our scientists advised of foreign scientific progress. What the scientist needs is the knowledge of the fact that information exists that has a bearing on his problem; this can best be done by proper preparation, indexing, and retrieval of abstracts. Then material that is of interest can be translated on request by private agencies and organizations. To tie up an appreciable fraction of the available competent translators in the herculean activity of translating, for example, Russian scientific journals that run to thousands of pages per year, is a rather inefficient effort for several reasons: (*a*) this procedure is very time consuming, and the translations lag by many month sthe actual availability of the information in the foreign language; (*b*) since so many translators are occupied with the relatively few publications they are not available for the translation of needed information from other sources; (*c*) the cost of such projects is very high and at the present time, is borne by the United States taxpayers through financial support lent by various governmental agencies such as National Science Foundation, Department of Health, Education, and Welfare, etc. It must be realized that translation of 5, 10, 20 or 60 Russian journals in their entirety does not cover the whole spectrum of available technical knowledge or even an appreciable portion thereof, but it does hamper seriously efforts that would bring to the attention of the scientist all or most of the available information. The key to the problem rests in all-inclusive abstracting of foreign scientific publications. This is the most efficient way of keeping up with the progress of science and technology abroad. It is not only the most efficient, but in fact, about the only possible way of doing the job well, namely: all-inclusively, competently, and with the least delay from the date of availability of the foreign information. Scientists who are already overburdened by reading ever-mounting floods of scientific literature, could not possibly find the time to read or even peruse translations of Russian journals running into the thousands of pages. Furthermore, no single scientist is even interested in this broad spectrum of information. Each scientist and in fact, groups of scientists, have fairly restricted and specialized interests which can be best served by providing this specialized information. This can be done most effectively only through the use of abstracts in one form or another.

In this connection the committee should secure all possible information on the availability of abstracts by contacting all of the available agencies that perform this service. Once this is done, only then can an intelligent evaluation be made of the actual needs for expansion or modification of services in the field of abstracting.

(6) Lastly, it would seem to me that thought should be given to programs that would stimulate and encourage the study of languages by the prospective scientists and engineers. Since they are the users of the information, their needs could best be served if they were able to read the original information themselves. This would also make it possible for them to exchange ideas and information at international meetings and visits without relying on interpreting services that are very rarely fully adequate, as seldom is an interpreter as familiar with the problems discussed, as the scientists themselves. In this connection with the overall efforts of the Federal Government in the area of scientific and technical education, it would seem advisable to include the consideration of support to those programs that would stimulate effective study of foreign languages by scientists and engineers. Such programs could also supply the needed professional scientists-translators that are in such short supply today.

I am deeply interested in the activities of the committee and hope that you will keep me informed of its efforts.

Very truly yours,

LEON JACOLEV.

BRONX, N. Y., *May 2, 1958.*

Hon. HUBERT H. HUMPHREY,
Chairman, Subcommittee on Reorganization,
Senate Office Building, Washington, D. C.

DEAR SENATOR HUMPHREY: It was exceedingly gratifying for me to be present at the hearing of the subcommittee on May 2. Your patience and understanding contributed greatly toward producing information from the testifying witnesses.

I could not help but come away with the recognition that Mr. Reynolds and the staff have manifested competence, thoroughness, and fairness in their preparatory work.

I enjoyed chatting with you personally at the conclusion of the hearing. It is my intention to endeavor to be present at the last scheduled hearing on May 7.

As I expressed to you, I believe that I have something to offer in the way of recommendations plus responses to a couple of questions that you posed at the hearing.

I am enclosing a statement in duplicate expressing the background for my interest in the subject of a program for the coordination of scientific and technical information, including my recommendations. My preference would be to have this statement included in the testimony of the hearing.

Of course, I am at the call of you and your committee to expand upon any of the points that I offer or to answer any questions.

With best wishes.

Sincerely,

EDWARD J. LOWY.

STATEMENT OF DR. EDWARD J. LOWY, RESEARCH CONSULTANT

I am Dr. Edward J. Lowy, of Bronx, N. Y., a research consultant. For approximately 23 years I was president of Kem Laboratories, Inc.

During World War I, when the American Expeditionary Forces arrived in France, our high command recognized the inability to place its fingers, at will, upon the location of any unit, large or small, let alone an individual. General Pershing called in Maj. Gen. Robert C. Davis, the then Adjutant General of the United States Army and assigned the problem to him, of making order out of chaos. Davis assigned this specific problem to his Chief of Staff, Col. Earle Boothe.

Colonel Boothe, an organizational genius, set up at Bourges, France, a suburb of Paris, the Central Records Office, which solved the entire problem, making it possible to locate, at will, any segment of the United States Army.

In 1939 Colonel Boothe became director of the blood-for-Britain program. Shortly after Pearl Harbor, this program was turned into our blood program under the direction of the American Red Cross. Boothe was director of this program, organizing and establishing the first blood donor center.

From early 1942 through 1949, I was closely associated with Colonel Boothe in a voluntary executive capacity in many areas of Red Cross work. I had the opportunity, because of our close association, to share in the many rich experiences of Boothe. It was only natural that I should take Boothe's World War I experience and apply it to the field of science.

My thoughts were directed to the waste of scientific man-hours through duplication as well as lack of information: the tragedy of an individual or team working on a problem for years, only to learn subsequently that someone had come up with the answer a long time ago. The extreme value that knowledge of work done by others would have to the individual scientist, team, or large group is obvious.

In early 1949, after consulting with Colonel Boothe, I directed a letter to the Academy of Sciences outlining an all-embracing plan for coordinating scientific and technical information.

In 1950 Congress passed a law extending authority to the Commerce Department to search out and catalog scientific information from domestic and foreign

sources. The authority included the maintenance of a clearinghouse for collecting and disseminating this information.

On August 1, 1957, Secretary Sinclair Weeks released a statement that his Office of Technical Services with its 35 employees was performing the function of a central clearinghouse.

On October 29, 3 weeks after the first Soviet satellite, Weeks said that the Commerce Department was aware of the importance to our industry and scientists of the communication of discoveries and advances in technology, and therefore, he had under study methods of increasing its contributions.

On January 14, a Government announcement was made that a program was being started to keep scientists abreast of Soviet research and that a clearinghouse would be established in the Commerce Department for translating and distributing Soviet scientific reports. In addition, through the National Science Foundation, the Government would step up translation of Soviet documents.

At the Soviet All-Union Institute of Scientific and Technical Information, located in Moscow, 2,300 translators, abstractors, and publishers are employed, supplemented by a part-time staff of 20,000 translators and abstractors.

At a public hearing of the House Government Operations Subcommittee on Government Information, the National Science Foundation revealed two highly interesting points: That American industry had spent 5 years and $200,000 for research on the design of a certain type of electrical circuit only to discover that this work had been described in a Soviet scientific journal before work on this problem had been started in our country. Also, that the radio frequencies to be used by the satellites had been published in the June and July issues of Radio, a Soviet magazine for radio amateurs. This information had not been translated and relayed to American scientists. As a result, we were caught by surprise by the frequencies of the satellites, and we worked frantically to convert stations to track them.

The President's Committee on Scientists and Engineers, and the Department of Health, Education, and Welfare have made many recommendations for improving the numerical and qualitative output of students in scientific and professional fields. These are quite impressive.

I am concerned, however, that the combination of satellites and publicity will have a tendency to create a crash program to develop military and scientific achievements, as well as upping the number of new students. Of course, this would be consistent with our American philosophy to endeavor to solve all problems by allocating money and increasing the number of persons involved. This is fallacious. In addition, the social sciences and the scientific and professional studies, without military value, must be maintained, furthered, and not sacrificed.

As we bring the scientific and professional picture into sharper focus, we make the following observations:

1. That we can no longer afford the luxury of high-sounding ideals without parallel action.

2. That we can no longer afford the luxury of a completely unrelated host of scientific activities when competing against the Russian-controlled economy with its completely cohesive scientific program.

3. That a mere increase in the number of students and an increase in dollars expended will not provide all the answers. The scientist must be provided with additional tools which will increase the individual or team qualitative and quantitative output.

4. As the heat grows for a greater scientific output, there is a corresponding astronomical growth in the number of papers originating through the world.

5. The most prodigious reader, operating completely on his own, could not hope to keep up with scientific advances.

6. The lack of a cohesive program on the part of the Government operating in scientific areas, sets a poor example for the rest of the country.

7. There has to be a consciousness developed that all the many scientific disciplines operating in government, educational institutions, and industries require the most modern means available to bring to them the available information necessary for their specific study and problem.

8. That is a restless world, time is running out. We are confronted with a dual problem of individual survival and a collective responsibility.

(*a*) With men dying of disease all over the world, we must have a cure today and not tomorrow.

(*b*) With new weapons of destruction being developed, we must have a defense today and not tomorrow.

(*c*) With natural resources being depleted, we need answers today, not tomorrow

(*d*) With people all over the world going hungry, food must be made available today, not tomorrow.

9. That better communication would permit us to multiply the output of our existing supply of scientists, stimulate creativity, and minimize duplication.

10. That no truly uniform picture exists, in some areas no abstracting exists, while in other areas there is duplication.

11. There is too great a lag in time between a conclusive finding and its availability to interested users.

12. That we must, without delay, exploit the world's scientific and technical information for the benefit of all mankind.

The following are my views and recommendations for moving into the action phase of an all-embracing program:

1. That a Department of Science and Technology be created with Cabinet status.

(*a*) That all existing governmental agencies active in scientific areas be made part of and subordinate to this Department. The exception would be where a scientific activity would be of greater value in its present niche, such as the Department of Agriculture.

2. That there be created under this Department a national center for the coordinating, processing, and disseminating of scientific and technical information in all disciplines with constant followthrough to assure its growth.

That this be accomplished through taking advantage of existing facilities with the technical know-how, assisted by Government grants.

A formula to be created, determining the scale of fees that a user would pay. I foresee users being classified into different grades of membership. Educational institutions would pay nothing, or a nominal amount, with large industries contributing substantially. I am quite confident that many large industries would want to be identified as sponsors in order to assume a certain posture in the eyes of the American people.

3. We now approach the most difficult aspect of the entire program, namely, whether to get cooperation of all segments of the scientific community on a legislative or voluntary basis. There are positives and negatives in both instances. There are objections to the Government taking over completely because of reasons, some valid, and some manufactured. There is no question but that certain situations which took place during the past few years have made some wary of the Government. A scientist prefers a completely free environment. There are others who are normal and possess normal selfish motivations.

(*a*) In order to circumvent all objections, I recommend the creation of a national council, representative of Government, foundations, professional and scientific disciplines, professional and scientific societies, industry, educational institutions, private scientific journals, abstracting organizations, and all other interested and affected groups, who would come within the framework of an all-embracing scientific program.

(*b*) That one of the great foundations of our country, having the esteem of all, and whose motivations would be questioned by none, and which foundation believed in this program, to be the sponsor and catalyst in a conference or series of conferences, in order to bring about the organization of the council.

(*c*) The Department of Science and Technology would publish in advance its support and desire for the creation of this counsel with a subsequent all-embracing program.

(*d*) The permanent leadership of this movement would be assumed by the council.

(*e*) The council would spell out the role that each participant in the many areas would play within the framework of this all-embracing program.

(*f*) The council would spell out the financial responsibility of each participant within the framework of this all-embracing program.

(*g*) Determinations would assist in assuring maximum cooperation from each group with the minimum duplication of effort by any group.

(*h*) The overall program would be built according to the thoughts of those active in the scientific and professional disciplines. Ultimate objectives information, and data would be shaped to meet the needs of those for whom it would be intended and of value.

(*i*) The existence of the Department of Science and Technology with the parallel existence of the organized council would permit a two-way flow for the creation of policy and needs.

(*j*) The value of the Department of Science and Technology and of the council during this period of stress, would be enhanced a thousandfold in the event of a national emergency.

(*k*) The scientist crying for an increase in status would become content.

1. I fully recognize the many hazards involved in the creation of the voluntary aspect of the suggested plan. I am fully aware of the necessity for an educational approach in gaining the voluntary cooperation of all individuals and groups.

I am very mindful of tradition, individualism, vested right reasoning, and the desire of some for secrecy.

I have complete confidence in the spirit and will of those active in the many fields of science and technology, for, in the final analysis, they are Americans.

The climate of defensive, negative, and panic thinking must give way to the positive approach of inspiring and planning. This should result in a richer life because we have only reached the frontiers of scientific achievements. Research is a tool which has made the progress of civilization possible. An increase in available information will increase the size and value of our tool chest.

This program can be extended through the United Nations to include an international exchange of scientific data with all countries. This would contribute greatly toward creating a climate of confidence, faith, and good will which is the only answer to a lasting peace.

Statement on Needs for Centralized Information Services

Report to National Science Foundation, December 31, 1957 (grant No. G–4105); principal investigator, Allen Kent

In order to throw light on the situation with regard to needs for improved exploitation of the world's scientific and technical information a number of national surveys have been undertaken under various auspices.

A report was prepared under a grant from the National Science Foundation whose basic purpose was to systematize and to analyze the results of 8 studies and surveys which I carried out during the past 3 years in fields which would be expected to throw light on the feasibility and need for centralized and cooperative information services. A summary of these surveys is given in the accompanying tabulation.

These surveys included:

1. Metallurgical organizations;
2. Chemical organizations;
3. Ordnance establishments;
4. Two surveys of several thousand United States organizations;
5. Defense establishments;
6. Professional societies; etc.

Summary of surveys

Name of survey	Sponsoring agency (or purpose)	Types of organizations or individual surveyed	Type of survey	Size of survey			Manner of choosing sample
				Number polled	Estimated percent of total population	Number of replies	
1. Special classifications and information systems.	Special Libraries Association (SLA).	All active members of SLA	Question-	[1] 4,000	100 percent	[1] 496	Total active membership SLA.
2. Nonconventional information systems.	Confidential	Those known to CDCR personnel as operating nonconventional retrieval systems.	do	25	10 percent at that time.	22	Literature survey supplemented by personal knowledge of systems not yet in published literature.
3. Ordnance library use	Office of Ordnance Research Liaison Committee.	Ordnance arsenals and proving grounds: (a) To research or administrative management. (b) To library or technical information personnel.	do	(a) 14 (b) 14	75 percent	(a) 10 (b) 10	Sent to establishments represented in OOR Liaison Committee.
Cooperative information processing metals.	Conference on Practical Utilization of Recorded Knowledge.	Metals information processors and metals literature users.	Invitational forum.	30	80 percent	15	Sent to those organizations known to be processing metals literature for use by others.
5. Ordnance report processing.	Development and Proof Services, APG.	Ordnance arsenal librarians	Sampling of processing	12	65 percent	10	Sent to those establishments on OOR Commission for which processed unclassified reports would be located at Development and Proof Services.
6. Special libraries in metals industry.	For paper before Metals Division, SLA.	Management of metals company.	Questionnaire.	100	Less than 5 percent.	45	Sampled from Fortune list of 500 largest earning companies.
7. Documentation needs of chemists.	Division of Chemical Literature ACS.	Members of Division of Chemical Literature (DCL) and of ACS in general.	Open forum.	25	2.5 percent of DCL. 0.03 percent of ACS.	25	Open forum publicized via Chemical Engineering News: Total ACS circulation via Chemical Literature; total DCL circulation via releases to all regional bulletins of ACS.
8. Information processing individual organizations.	For paper before Symposium for Information Retrieval (April 1957).	Special librarians	Questionnaire.	2,000	100 percent	604	All special librarians listed in 1953 SLA directory.
9. Information processing, professional societies.	For paper before Symposium on Systems for Information Retrieval (April 1957).	Professional and technical societies.	do	100	15 percent	60	Sampled from list in World Almanac.
10. Information centers	Department of Defense		Literature survey.				Prepared for meeting of Study Group on Information Centers by 1 of the Service participants May 16, 1957.

[1] Many special libraries have more than 1 active member in SLA; therefore, many blank questionnaires were returned with the notation that 1 consolidated questionnaire was prepared. Those blanks were not counted.

The results of the surveys indicate that there are a variety of forces working toward full centralization, toward limited centralization, and toward decentralization of activities directed to the processing for more effective use of recorded scientific and technical knowledge in general, and published periodical and report literature in particular.

It was noted that there is a strong and insistent expression of need for additional information processing activities.[1] The need for additional services has manifested itself in two ways:

(1) Pressure for more centralization in information processing (appendixes D, G, and H).[1]

(2) By the commitment of considerable funds and manpower to process the desired recorded information by an individual company or other organizational unit in Government beyond that processing that is provided by an existing centralized service.

The latter manifestation can be read from a number of signs, as follows:

(*a*) Development and use of special classifications (appendix A).[1]

(*b*) Use of new tools and devices to facilitate retrieval of information (appendix A, table V; appendix B, table I; appendix H, fig. 2; appendix J, table II).[1]

(*c*) Abstracting and indexing of published or report publications (appendixes C, H, and I).[1]

(*d*) The development of information processing activities in specialized fields.

It is evident from these studies that use of recorded scientific and technical information is now achieved through a number of types of services, ranging from the personal readings of individuals requiring specialized information, to the use of various degrees of centralized service. The desirability of additional services are voiced, at various levels of organizations structure, e. g., by librarians and information specialists (appendixes G and H),[1] by scientists and engineers (appendixes D and G),[1] and by research management (appendixes D and F).[1]

It appears that the expressed needs for additional centralized information processing services have their origins in a number of causes. Before enumerating some of the causes that seem most important, it should be stated in preface that all needs are relative, since in an absolute sense, all recorded information in the world can theoretically be made available by total reading in connection with any problem. However, retreating from this absolute case, there are an infinity of combinations of information services possible, and a whole spectrum of possible use that can be made of these services by a variety of users and at a variety of levels of efficiency. Despite this very complex set of variables the following causes for expressed needs for centralized services may be isolated:

(1) An actual gap in service may exist (for example, in certain fields, spotty service may be all that is being provided by centralized abstracting; also some fields are not provided with an effective index of periodical literature).

(2) A service may exist, but it may not be sufficiently prompt or it may not be provided in a form for convenient use (for example, in certain competitive fields, more than a month or 6 weeks' delay in abstracting or indexing the periodical literature may provide individual organizations with competitive motivation for their processing at least a considerable portion of the literature themselves; further, many literature users find it convenient to have abstracts on unit records, while central processing activities are lagging far behind in providing this form of publication).

(3) A service may exist, and be theoretically able to meet user needs effectively, but available communication and information transmission facilities are not used imaginatively in order to meet user requirements (for example, many "clients" of central library installations are inhibited from obtaining effective service because of the problem of overcoming inertia in visiting more or less distant locations where information repositories may be located; the use of closed circuit television, for example, may provide cost and service advantages over the proliferating of branch repositories with more limited means).

(4) A service may exist, and be theoretically able to meet user needs, but the service is not known to the potential user. (As with many other products and services, information services must be "sold".)

(5) A given information service may exist, but, because of the bulk and complexity of information in the field covered, the system used for dissemination of

[1] Report from the Center for Documentation and Communication Research, School of Library Science, Western Reserve University, Cleveland, Ohio.

information is not able to cope with sufficient effectiveness with user demands.

(6) Specialized information needs may not be able to be met on a decentralized basis because of—

(*a*) shortages of trained personnel to man the service;

(*b*) insufficient economic justification for duplicate processing facilities, whereas a community of needs may support a single facility.

It is obvious from the above that some of the pressures trending toward centralization of information processing are based on firm foundations of need, while others result from lack of knowledge of what is available. On the other hand, it must be noted that many centralized information-processing activities do not take advantage of the technical possibilities for providing services to potential users, and thus broadening the economic base and justification for their activities.

Just as there are pressures working in the direction of increasing centralized information processing, so are there pressures exerted to maintenance of limited centralization and even decentralization. Some of the more important factors that seem to be controlling in this regard are given below.

(1) The special points of view often peculiar to individual organizations argue in favor of special processing of the published periodical literature.

(2) Policies as to company security in maintaining specialized interests in the forefront in processing and using recorded information may be another factor influencing decentralization.

(3) The stated requirement for promptness in processing of published literature, considerably more promptly than apparently feasible in centralized services.

It has been my observation that despite the importance of specialized points of view and promptness of information processing which have caused the setting up of decentralized activities, the actual operational aspects of these activities do not often live up to the stated norms. Various operational exigencies, such as lack of trained personnel, budget deficiencies, etc., tend to bring the quality of the decentralized service to a performance level that could well be provided centrally at lower overall cost and saving of technical skills (appendix E).[1]

NEEDS AS SEEN AT DIFFERENT ORGANIZATIONAL LEVELS

In examining the responses to the various surveys and questionnaires, an attempt was made to determine the consistency with which answers to questions directed to similar problems were answered at different organizational levels within the same company.

A number of clear-cut cases were identified in which questions bearing on a similar topic were answered in two or more different questionnaires.

The main area involved in the cases reported is that concerning the need for additional centralized abstracting and indexing services to supplement information processing activities in an organization.

In 25 percent of the cases, the librarian or information specialist indicated that no additional economies or increase in efficiency of exploitation of the published literature could be achieved through auxiliary services from professional organizations, etc. However, in other independent questionnaires, the research directors or vice presidents in charge of research of the same companies indicated dissatisfaction on the part of 25–50 percent of the scientists and technicians using the literature facilities provided to them. In one of these cases, it was estimated that 75–100 percent of the users were dissatisfied. In 20 percent of the cases, main use of the literature was reported as having been performed by the scientists and engineers, and use to a minimal degree by the librarian.

In 45 percent of the cases the librarian or information specialist indicated that economies or increase in efficiency of exploitation of the published literature could be achieved through auxiliary service from other sources.

It would appear that those persons making use of the literature in depth are most aware of limitations of presently available services. There is further evidence for this conclusion in the following. It appeared that those organizations in which both the librarian indicated substantial expenditures for processing of published literature for internal use (over $10,000 in 1956), and where the vice presidents indicated that a substantial percentage of the research time of scientists and engineers (over 6 percent) was spent on the use of recorded information, in most of those organizations was there greatest desire for increased centralized information processing services from outside sources.

[1] Report from the Center for Documentation and Communication Research, School of Library Science, Western Reserve University, Cleveland, Ohio.

CONCLUSIONS AND PROPOSED PROGRAM

The special collections of scientific, technical, and engineering information that are being handled by various organizations in the United States are growing in size and complexity (appendix A). Much effort and money are being invested by individual organizations in processing recorded information for more convenient use (appendixes B, F, and H). Centralized processing of scientific and technical information by professional societies is in many cases not providing full service (appendix I) to members. Costs incurred by individual organizations (appendix H) often exceed those incurred by centralized services (appendix I), and demand for further centralized and cooperative processing and service beyond that now being provided centrally is evident from many sources (appendixes D, G, and H).

Although there is a clear indication of desire for additional centralized service, the results of the various surveys reported indicate many negative responses with regard to need for additional services. It is my opinion that many preconceived notions with regard to types of information services that can and cannot be supplied conveniently from centralized services have influenced extensively many responses and comments made in connection with the surveys and questionnaires. In particular, many of the possibilities inherent in modern aids for the storage, retrieval, correlations, transmission, and dissemination of recorded information are not sufficiently well understood by the majority of possible users of potential services that they are able to judge a priori the capabilities of these available tools.

It was, therefore, one of the major conclusions of this study that an effort should be mounted to preparing detailed descriptions and models of centralized and cooperative information-processing activities at various levels. These descriptions and models would provide a tentative blueprint for the future of centralized information processing, especially with regard to the evaluation of the actual and potential contributions of available and proposed services at various levels.

Senator HUMPHREY. Later on, we will have all the affected Government agencies before the subcommittee. That will be sometime in June. Ordinarily, we hear from the departments and agencies first and then come around to the private witnesses. In this instance, however, because we were pioneering rather new ground, and were uncertain as to just how we might proceed in terms of ultimate legislation. if any, we thought it would be good to call witnesses who are informed on the issues involved from all sections of the Nation. We thought even the agencies might learn something from this, and I say that with all due respect to them, because there is so much to be learned and so much to know.

With that, I would like to have Dr. Hutchisson give us his advice and counsel on these matters.

We are very pleased that you are here. You are the head of one of the great institutes and, surely, a very important man and directing your attention to an important subject. You may proceed.

STATEMENT OF DR. ELMER HUTCHISSON, DIRECTOR, AMERICAN INSTITUTE OF PHYSICS

Dr. HUTCHISSON. Thank you, Mr. Chairman. With your permission, I should like to read a statement that I have prepared.

My name is Elmer Hutchisson. I have been concerned with documentation for many years. I am a native of Ohio and a graduate of Case Institute of Technology. May I say further that I was drawn to the University of Minnesota for my graduate work.

Senator HUMPHREY. I knew this was not only a diamond in the rough but one, may I say, that had been fully processed.

Dr. HUTCHISSON. I might even add I have a gold medal from the University of Minnesota, of which I am very proud.

Senator HUMPHREY. I am very pleased to hear that, and I am sure you deserve it; the university showed good judgment.

Dr. HUTCHISSON. I have been in academic work for a long time. I was at the University of Pittsburgh for many years before the war. During the Second World War, I was with the Office of Scientific Research and Development in Antisubmarine Research. After the war I went back to Case Institute of Technology as dean of the faculty and as acting president for 2 years and more recently as dean of the graduate school.

For 17 years I was editor of a journal of applied physics. I have been chairman for many years of the science abstracting committee of the American Physical Society, and the American Institute of Physics.

I was chairman of an advisory committee on Russian translations for the American Institute of Physics for several years. And I am at present, vice president of the International Abstracting Board of the International Council of Scientific Unions.

My present position is director of the American Institute of Physics, a federation established by the five principal physical societies in America: the American Physical Society; the Optical Society of America; the Acoustical Society of America; the American Association of Physics Teachers; and the Society of Rheology.

Senator HUMPHREY. What is rheology?

Dr. HUTCHISSON. Rheology is the study of the flow of very viscous liquids, that is the study of the properties of flow of materials like molasses. It is particularly concerned with those liquids which are very viscous and have a different kind of a flow than very fluid liquids like water. The Society of Rheology is not a large society. I would guess there are perhaps five or six hundred members in this society. But it is an important society industrially. Its members are concerned with such matter as the flow of lava in the volcanic structures, and even such materials as glass which are really supercooled liquids and have different flow properties from those of the very fluid substances like water.

Senator HUMPHREY. I digress again, Doctor, just to give you an out-loud reflection. It is just wonderful to see these men of science like yourself come before the committee and express their views so frankly and so candidly. I don't know how many Americans feel this way, but I am sure most of us do. I think this is the real strength that we have. It is so difficult to get people from the totalitarian areas of the world to be open and free in their discussion, even when you are in private discussions with them, which some of us had the privilege of undertaking. Here we have the privilege of not only expert knowledge but opinions and observations, which, as we add up this total picture of the assets and the liabilities of the respective systems or forms of social structure and organization, I think we have one factor here that we must never underestimate: That of freedom of inquiry and freedom of expression as a result of this inquiry. I want to say that for the record.

Dr. HUTCHISSON. Thank you, sir.

Senator HUMPHREY. I am very grateful to all of you who come here. The acceptance of patriotic service to the Nation is something the American people really ought to appreciate, and I am sure they do.

Dr. HUTCHISSON. May I say, sir, that it is an honor for the scientist to be asked to appear. We are very happy to do so. Also I think

it is fully understood by the scientists that we can't have a good climate in which science may thrive unless the public understands what the scientist is doing, what his general motives and objectives are. To me, it is critically important that we keep the public informed of what is going on in the scientist's world and assist the public in understanding the problems, so many problems of our modern society which are technological in character.

Senator HUMPHREY. You surely assist this member of the public. Thank you very much.

Dr. HUTCHISSON. Thank you.

Senator HUMPHREY. Go right ahead.

Dr. HUTCHISSON. The American Institute of Physics was founded in 1931 and has as its principal purpose the advancement and diffusion of knowledge of the science of physics and its application to human welfare.

The total nonduplicated membership of the five societies represented in the American Institute of Physics is approximately 18,500. In addition, there are some 40 student sections with a membership of about 1,200, 10 affiliated societies, and approximately 100 corporate associates. The physicists associated with the institute are employed in educational institutions, and in governmental and industrial laboratories.

In carrying out its purposes, the American Institute of Physics is concerned primarily with improving channels of communication open to physicists. These channels include communication between physicists themselves, between physicists and the public, and between physicists and the younger generation. Direct communications between physicists themselves occur in many ways; through visits, through letters, through meetings of the kind that were held in Washington, last week the American Physical Society, and this week of the American Acoustical Society of America, and through scientific journals.

Journal publication provides not only a permanent record of these communications, but also is probably the most convenient way for physicists to reach large numbers of their colleagues throughout the world.

Because of the close relationship of the American Institute of Physics' activities in disseminating scientific information, to section 107b of title I of the proposed substitute for S. 3126, I will describe our publication program in some detail. In the early days of scientific writing in America, journal publication offered few problems. In physics, there was only one journal. It was thin enough so that each phsicist could read it from cover to cover and still have time left for some research of his own.

With the growth of physics, this situation has changed markedly. Journals have become numerous and constantly more bulky. Even since 1945, there has been a fivefold increase in the number of pages of scientific research published in the American Institute of Physics journals.

The total publication output of the institute consists of 12 journals, containing approximately 20,000 pages per year of original archive research material in the field of physics, and 6 journals translated from the Russian with an additional 8,000 pages. The total number of subscriptions to all journals is approximately 90,000.

Senator HUMPHREY. Is that all in the United States of America or is some of that foreign?

Dr. HUTCHISSON. A large part of that is foreign.

Senator HUMPHREY. It is?

Dr. HUTCHISSON. Yes. I would say perhaps 20 to 30 percent. The fact that the number of pages in our scientific journals are increasing so rapidly, and the circulation is increasing so rapidly, has brought about two important serious consequences.

The first is related to the complex nomenclature which the physicist needs nowadays to express his ideas, for it has become virtually impossible with present methods of typesetting for printers to keep pace with the constantly growing volume of scientific literature.

The second relates to difficulties which the physicists themselves are having in absorbing adequately this new knowledge which seems to appear at an ever-increasing pace.

Both of these consequences are of serious concern to the institute. In an effort to ease the first one, we are studying on an urgent basis all new developments in typesetting in an attempt to find one, or a combination of methods, that will enable printers to keep up with this growing volume of material and yet maintain the standards of accuracy, speed, and low-cost reporting which physicists have become accustomed to.

At the present time, it takes 3 to 4 months to publish a scientific manuscript, and yet, news magazines operate on schedules of less than a week, and newspapers on schedules measured in hours. With the growing importance of science in our technological society, imaginative and vigorous thinking are necessary if we are to improve the speed of scientific publication.

Parenthetically I might mention that the time between the discovery of a scientific fact or scientific theory, and its application to human welfare or to military strength, is rapidly decreasing. And the fact that this time is decreasing constantly makes it very important that we have faster publication.

Senator LAUSCHE. What is your understanding of the time lapse at present?

Dr. HUTCHISSON. The time lapse in scientific journals is in the neighborhood of somewhere between 3 and 6 months. Perhaps for a few journals it is even longer than that. We hope to cut this timelag down very materially.

For example the American Physical Society is planning, within a few weeks, to bring out a new fast publication which will consist principally of letters now submitted to the editor of the Physical Review. I might mention parenthetically that many of the most recent developments are published in the form of letters to the editor, and these are the letters of which I am speaking.

It is hoped that this new publication will have a printing schedule of 10 days to 2 weeks, and will offer to physicists the fastest way yet available of publishing their research in the detail and with the accuracy required for this type of material.

Senator HUMPHREY. Why is there this lag in the mechanical operation of the printing? Is it because of the complex nature of the symbols and sentence structure?

Dr. HUTCHISSON. The complex nature of the typography is an important factor. There are many mathematical equations that are

required in most reports of scientific work. These have to be set up by printers who are phenomenally able to set type correctly for these equations. We can't really quite understand how they can do it so well, not knowing the basis for the formulas themselves. Nevertheless, mistakes are made and the mistakes could be very serious in reporting the results of research. To correct errors, a proof has to be sent out to the author, it has to come back, and this process of sending out the proofs, getting them back, making corrections, takes much of the time. I think the time could be reduced, but at present the kind of typesetters who can set this complex material are in short supply, and actually most of those that are engaged in that are rather elderly at the present time and are close to retirement ages.

There isn't much incentive for young men to go into this typesetting operation, so that the young men don't get enough experience to be able to set this complex nomenclature. This is a problem we are very much worried about because we are finding that typesetters themselves are a bottleneck for many of our publishing problems.

Senator HUMPHREY. Have you taken this problem up with the people in the organized trades?

Dr. HUTCHISSON. We have taken it up to some extent. I think we have not gone as far as we might. It was only brought to our attention in a really dramatic fashion a few months ago. But we are attempting to introduce articles into some of the printing magazines, that go to the typesetters, describing the need for this kind of work. Part of the difficulty is that the typesetters don't understand the importance of this work, and to them it seems very slow and somewhat boring. Yet from the point of view of the Nation it is a very important ability and one which, if they understood it correctly, the typesetters would have a great deal of pride in.

Senator HUMPHREY. A breakdown would be rather disastrous?

Dr. HUTCHISSON. It certainly would.

The second part of this problem, that of helping the physicist to keep a jump ahead of the avalanche of information and journals that seem to come his way, is even more difficult. In some fields of knowledge, mechanical and electronic indexing and retrieval systems show promise of being of assistance in calling to a worker's attention all the literature related to a given subject in which he is interested. Mechanical devices seem to be particularly effective in metallurgy, organic chemistry, and other fields where one is interested in a large number of properties of a single alloy or compound. They apparently are not nearly so useful or effective in many of the rapidly developing fields of physics.

The reason for this seems to lie partly in the difficulty of abstracting and indexing complex physical theories, and partly in the manner in which physics progresses with alternate steps forward in experimentation and theory. In this progression, an experiment is performed and is then followed by a theory to explain or relate the new knowledge to other generally known phenomena.

The resulting theory suggests new experiments which, in many cases, make the existing theory or the early experiment obsolete. As this process continues, there is a rapid obsolescence of the earlier work and of the need to refer to it in detail.

For this reason, an index and a set of abstracts which provide merely an uncritical accumulation of references in which obsolescence

is disregarded tend, in many cases, to confuse and swamp the worker rather than to assist him. Thus, physicists are asking more and more for critical reviews which they believe are of much greater value to them than automatic indexing and retrieval systems.

I have spoken of the difficulties in printing journals and those of physicists in keeping up with the amount of material being published. I have not stressed the financing of the journals. Several years ago, the editors of our physics publications stressed the fact that research was not complete until the results were published and distributed, and that the cost of publication was a legitimate part of the cost of carrying out this research. This philosophy led to a policy of charging a definite amount per page for publishing research.

This charge is made to the supporting agency, not to the physicist himself. This has become known as a "page charge," and at the present time, amounts in some journals to as much as $25 per page. Such a page charge covers most of the cost of composition, and thus makes it possible to distribute copies of the journal at very low subscription prices to the members of the various societies.

As a result of this practice, scientific societies in the field of physics are able to publish the results of most of the good research carried on in America. I should emphasize that the payment of the page charge is voluntary, and no papers are refused because the per-page charge is not paid.

Actually, however, from American university and industrial laboratories, the bill for page charges is almost universally honored—90 to 95 percent. The same is not true for research originating in Government laboratories where less than 50 percent of the charges are honored.

In many cases, we are told, there are legal difficulties in paying the page charge, and a real service to the publication of American research in the field of physics would be an authorization by the Congress for all agencies to pay the page charge that scientific journals need to charge in order to survive.

Senator LAUSCHE. Do I understand correctly, that services provided for the private individual and corporation are paid as high as 90 to 95 percent?

Dr. HUTCHISSON. May I make it clear that the payment which is made is the payment essentially for the cost of composition in the scientific journal, that is the cost of setting the type and doing the things which have to be done before the issues are printed.

Senator LAUSCHE. Those charges are honored up to 90 to 95 percent, but with the Federal Government that is only 50 percent.

Dr. HUTCHISSON. That is correct.

Senator LAUSCHE. You are suggesting a remedy of that failure on the part of the Government to honor the charge?

Dr. HUTCHISSON. Yes. May I say that I understand that the failure to pay is tied in with the fact that there is a Government Printing Office and I believe that the difficulty is that many of the Government agencies feel as though they cannot help support other printing agencies such as those which print the American Institute of Physics journals. They feel they cannot help support scientific journals published by the Institute while the Government Printing Office exists.

May I also mention, that many of our physicists are in academic institutitions. They cannot pay the high prices which we would need to charge if we were unable to make this page charge initially.

It is the philosophy of most of our journals in America to have large numbers of subscriptions so that each scientist can have his individual copy of the maga ine. This is not the policy followed; for example, in Germany or in many of the other countries they charge large subscription prices and journals are available only in libraries.

We feel very strongly that science is furthered if each scientist has his own copy of the journal. This becomes possible if we can take care of the large charges through the page charge and then supply him the journals at the small cost of actually running off the presses the individual copies that he is interested in. It is for this reason, that we are so concerned about the payment of the "page charge" by Government agencies.

There is no American abstract journal covering the field of physics completely, such as there is in chemistry. There is, however, a journal known as Physics Abstracts published by the Institution of Electrical Engineers in Great Britain. This journal serves the needs of American physicsts very well, and is published at a considerably lower cost than we could publish a similar journal ourselves. A large part of its support is provided by the American Physical Society. The American Institute of Physics cooperates actively with the Institution of Electrical Engineers in improving Physics Abstracts, and in making it widely available to American physicists.

As I proposed earlier, I have described in considerable detail the information services of the American Institute of Physics since they are related to title I of the proposed substitute bill for S. 3126 in which the Federal Government would establish a complete science information program. I cannot, of course, speak for all physicists, since they have not had an opportunity to express themselves on these matters, but I believe I speak for the majority of physicists in saying that the present organization for information dissemination is working remarkably well, and that it would be undesirable to establish a competing service within the Federal Government.

In order for science to thrive in any country, it is necessary that there be a simple and easy means for members of a given scientific field to exchange information among themselves. The present organization for this purpose in physics is one that has been set up by the physicists themselves, and has been modified from time to time as the needs of the physicst have changed.

It is believed that if a universal national information system were set up attempting to cover all fields at once, it would be so unwieldy that it probably would not satisfy the needs of any particular discipline or field as well as the services now in existence. It is true that from time to time it is difficult for a person in one discipline to find information in another discipline, but we do not believe that this need is so important as to justify a large central organization, which might make it considerably more difficult for the members in a given discipline to exchange information among themselves.

I do recommend, however, that the Federal Government establish an information coordinating agency with funds to help carry out those tasks which existing organizations are unable to carry out. Such an organization should not duplicate any of the activities of existing information services. It would be hoped that such a coordinating agency would, for example, have the funds available for special research programs on scientific publication. Studies leading to the

development of more rapid and more precise methods of printing need to be carried out.

It is desirable to provide funds also to assist the professional societies in obtaining critical review articles. It may easily take several months of time for a top-ranking physicist to review critically the progress made in the past few years in a given field. Yet, such a review would be of tremendous help to those now working in the field. It would be hoped that funds might be provided so that physicists of high caliber could be persuaded to take the time off from their other duties to write such critical reviews.

Assistance is needed in finding better indexing methods for our journals, and to study the application of mechanical and electronic indexing, and storage and retrieval devices, and the relation of them to documentation problems.

Since, however, whatever research that might be done in the field of physics would have application in other fields, it would seem to me very proper to have research on these activities coordinated by the Federal Government. I think it essential, however, to have the initiation and proposals for such devices come from the societies themselves—coming essentially from the grassroots—who are very close to the needs of their members.

Because of the wide applicability of the results, it would be desirable to have funds available from the Federal Government to support those ideas that seem to offer promise of success. Any useful results obtained should be available to workers in all disciplines.

The essence of my recommendation is that there should be available in a Federal agency, such as the National Science Foundation, complete information on all information services. Further, it would seem to me to be well to center financial sponsorship of documentation research in the National Science Foundation, which knows well the needs of the research scientists as well as of the public.

With the great amount of money and time that has been invested in setting up information services in the various scientific fields, it would be unfortunate not to make the best possible use of these services, and far better to assist them in doing their job better, rather than to set up competing organizations.

I hope that what I have said will be useful in considering the substitute information services proposed for Senate bill 3126. I appreciate greatly the opportunity of testifying on the activities of the American Institute of Physics that relate to the proposals of these bills. If there are questions which I have not covered, or matters upon which I might give further information, I would be most pleased to do so.

Senator HUMPHREY. Senator Lausche?

Senator LAUSCHE. I have no questions.

Senator HUMPHREY. Senator Martin?

Senator MARTIN. Your conclusions are very direct and to the point. I commend you on your presentation.

Dr. HUTCHISSON. Thank you, sir.

Senator HUMPHREY. The National Science Foundation generally deals with basic research in the main, doesn't it?

Dr. HUTCHISSON. It includes engineering, so I think it would get into applied research fields also. It is primarily concerned with basic research in the physical sciences and in related fields.

Senator HUMPHREY. So you feel that the financial assistance, a type of grant-in-aid, so to speak, that the Federal Government might give, would be well directed by the National Science Foundation?

Dr. HUTCHISSON. Yes, sir. I believe this because the National Science Foundation is well informed and knows so well the problems which the research scientist has himself. As you know, sir, science is not anything which individuals do nowadays. It is a cooperative activity. Each person's work builds upon another person's work. So it is critically important that we set up a system which will enable the scientist to communicate very easily and readily with his fellow workers in his field.

Senator HUMPHREY. I am happy to get your view on that.

Are you saying then, in substance, that rather than to establish any new type of Federal activity, the scope of activity of one Federal service already in operation, namely, the National Science Foundation should be expanded?

Dr. HUTCHISSON. This, from my own somewhat limited experience, is what I would recommend.

May I just add one further word? Part of my reason for this recommendation is that it seems to me that the initiation of things which need to be done ought to come from the people working in the field, and I think this could be done if we had a coordinating agency rather than an agency which directed people to do various things, and which might not be sufficiently well acquainted with what the actual problems are of the worker in the field.

Senator HUMPHREY. I am a little confused about your recommendations on this basis, Doctor: In your statement you say:

> I do recommend, however, that the Federal Government establish an information coordinating agency with funds to help carry out those tasks which existing organizations are unable to carry out.

And then you go on to say:

> The essence of my recommendation is that there should be available in a Federal agency, such as the National Science Foundation, complete information on all information services. Further, it would seem to me to be well to center financial sponsorship of documentation research in the National Science Foundation * * *

Are you, in these two recommendations, saying exactly the same thing?

Dr. HUTCHISSON. Yes, sir. Perhaps I did not express myself clearly. What I had in mind was that the National Science Foundation has very limited funds for documentation research and information coordination at the present time.

When I spoke of establishing such an agency I meant establishing it within an existing organization, such as the National Science Foundation, although the important point is to establish the coordinating agency. I think you gentlemen know best where this agency could be situated.

Senator HUMPHREY. Or to establish within an agency a coordinating authority?

Dr. HUTCHISSON. That is correct.

Senator HUMPHREY. There are two possibilities here. One is that you could maybe set up some kind of a national advisory coordinating committee, with certain jurisdication and authority. That would be a new type of apparatus, or at least drawing several together.

Or, are you suggesting, we could take one of the established bureaus of Government and broaden its activity, and say to that agency, such as the National Science Foundation, "There are certain things that need to be done." Maybe a pilot project needs to be undertaken in terms of certain types of indexing, maybe we need more research in this field, or in documentation. "You (the National Science Foundation) will be responsible for implementing these objectives."

Is that what you are saying?

Dr. HUTCHISSON. This is exactly it, sir. I would add that it goes back to the philosophy which I expressed a little earlier, that has been developed, in which publication of research is part of carrying on research. In other words, no research job is complete until the results are published. Until other people know what has been accomplished, the research might just as well not be done.

The National Science Foundation, in sponsoring a large amount of research, should have at the same time the responsibility of seeing to it that it gets published efficiently and well and reaches the people that it is intended to reach.

Senator HUMPHREY. So it would become in a sense an information center about information, information centers scattered throughout the land, a sort of holding company operation, in a sense?

Dr. HUTCHISSON. That is right. If anyone then wanted to know anything about a particular field, he could then go to one central agency and find out all the people who know the details about this.

So that there wouldn't be lost motion in trying this library or that one or somewhere else in order to get that information.

Senator HUMPHREY. Did you hear Dr. Crane speak yesterday?

Dr. HUTCHISSON. No, sir, I did not, I am sorry.

Senator HUMPHREY. Dr. Crane is from Chemical Abstracts.

Dr. HUTCHISSON. That is correct.

Senator HUMPHREY. He gave very good testimony with reference to the work being done by that organization. Would you say that all the other disciplines, or sciences, or fields of scientific activity are as well documented in terms of their research as Chemical Abstracts?

Dr. HUTCHISSON. I am sorry I can't say that. I wish I could. Dr. Crane——

Senator LAUSCHE. Dr. Crane is watching you.

Dr. HUTCHISSON. He and I know each other from a long time back. I think there is no question in the minds of scientists throughout the world that the Chemical Abstracts Service is the best in the world. Through Dr. Crane's efforts of many years it has reached a perfection which we all admire and in some respects envy. From the point of view of original publications, primary publications rather than abstracts, we in the field of physics are very proud of what we have done. The American Chemical Society has also done very well.

My own feeling is, and I hope I am not thought to be too boastful here, that in the field of primary publications we do offer a very adequate service for scientists. In the field of abstracting and indexing we do not, I am sorry to say, do nearly as well as does Chemical Abstracts.

Senator HUMPHREY. Is your situation comparable to others?

Dr. HUTCHISSON. I would think it is fairly comparable. I really can't speak for the degree with which primary publications are published by other societies.

Through our introduction of the page charge that I mentioned, I think we are able to publish essentially all of the important research in the field of physics and do it probably somewhat better than some of the other societies. This has been really the thing that has saved us in spite of the tremendous increase that there has been in the amount of material published during the past few years.

You can see that with this procedure, as the research activity increases, the available funds for the publication increase at the same rate, so that we can publish this research fully and this is a very desirable feature.

Senator HUMPHREY. What I have been concerned about is that some of the witnesses may have the feeling that those of us on this subcommittee would be thinking of a service which would supplant the existing societies and services performed by the splendid research and abstracting groups that we already have. That is not my view and from what I have heard my colleagues express, I am sure it is not their view.

What we are trying to do is to find out if there are areas in which there are limitations and weaknesses in abstracting, indexing, documentation, and dissemination of information, and if there are those areas, what if anything should and can the Federal Government do about it.

I think we start on the assumption that the role is not one of taking over, but is one of a friendly helping hand. That is why I was a little concerned when we heard testimony, like Dr. Crane's testimony, which indicated to me that here is a service already doing what needs to be done in his field. I wonder whether we should judge all needs on the basis of the competence and development in the field of Chemical Abstracts. There may be other areas in which there are weaknesses. Those weaknesses might be able to be corrected by voluntary action strictly on the part of the societies. If so, it ought to be done.

But if there are areas in which there is delay and where there are weaknesses that apparently can't be corrected by the individual group by voluntary action alone, then the question is, Is that the place and is that a proper role or area for some assistance on the part of the Government, and if so, what?

Dr. HUTCHISSON. First of all, may I say that Dr. Crane's service is something which, as I said, has the admiration of all of us. He, undoubtedly, has some problems that he could speak to. All of us have problems, but they are probably not the same problems. We have problems in the American Institute of Physics. We do need funds in order to enable us to do some research on printing processes, to see if we can't find ways of speeding up the printing processes.

We do need funds to study the way in which backlogs of journals build up; to study how can we eliminate these backlogs that result in numbers of pages being unpublished.

We need to make studies into how can we assist scientists in absorbing this tremendous amount of material which is coming out.

These are problems. Some of them cut across all fields of science. Some are particular to physics itself.

We do need, and would like very much to suggest, that there be assistance for problems of this kind.

I spoke about the need for critical review articles. We would like some assistance in providing the funds so that these critical review articles could be written.

I spoke also about the need for finding some way in which the laboratories supported by the Federal Government can pay the "page charge" which we feel so strongly is part of the cost of undertaking research.

Thus, there are many problems in which we would like and would appreciate the help of some Federal agency. We would like such an agency set up in such a way that, as these problems develop within the various disciplines, we could go to that agency for assistance. We would not like to be directed to do this or to do something else which we ourselves didn't feel was really necessary.

Senator HUMPHREY. Did you participate in the Western Reserve Conference that has been discussed earlier at these hearings?

Dr. HUTCHISSON. I participated in a part of it. I was only able to be there 1 day. I did participate in the first day.

Senator HUMPHREY. Did you study the findings and recommendations?

Dr. HUTCHISSON. Yes, sir.

Senator HUMPHREY. Do you find yourself in the main in support or in agreement with those recommendations?

Dr. HUTCHISSON. I am afraid I am not completely in agreement on the basis that I am much more anxious to have an agency which coordinates rather than is an operating agency. If I understand it correctly, part of the Western Reserve proposal is to have the agency be an operating agency.

Senator HUMPHREY. Senator Lausche?

Senator LAUSCHE. Dr. Hutchisson, it is my understanding, No. 1, that you do not favor the establishment of a Federal operating agency which might, in any way, supplant the work that is now being done by private scientific agencies?

Dr. HUTCHISSON. That is correct, sir.

Senator LAUSCHE. No. 2, you find, however, that there are certain fields in which the Federal Government can justifiably participate, primarily to act as a coordinating agency, having information on all private information agencies and the ability of those agencies to supply information?

Dr. HUTCHISSON. Yes. I would also say on Government agencies as well.

Senator LAUSCHE. You suggest that the Government could help in operational work, No. 1, by making studies and financing them, of more rapid and more precise methods of printing.

Dr. HUTCHISSON. That is correct.

Senator LAUSCHE. No. 2——

Dr. HUTCHISSON. That is an example, may I say.

Senator LAUSCHE. No. 2, by providing funds to assist the professional societies in obtaining critical review articles.

Dr. HUTCHISSON. That is correct.

Senator LAUSCHE. And No. 3, by financial aid in finding better indexing methods for your journals, and for the making of studies for the application of mechanical and electronic indexing.

Dr. HUTCHISSON. That is correct.

I might mention, sir, I did not mean that there would not be other things that occur. These were merely examples of possible areas in which help is needed at the present time.

Senator LAUSCHE. Am I correct in my understanding that primarily, however, you want the research work, the continued existence of the present scientific agencies, to remain unimpaired through Federal interference?

Dr. HUTCHISSON. I believe I would agree with that.

Senator HUMPHREY. Senator Martin?

Senator MARTIN. Is there any thoroughly established system of indexing that would suffer should the Federal Government move into that field? The indexing, cataloging, abstracting, and so on.

Dr. HUTCHISSON. I think it depends upon to what extent the Federal Government, as you say, moves into the field. I could readily imagine that if the Federal Government moved into the field of chemcal abstracting it would be duplicating much of the work which is already being done and would not be helpful.

Senator MARTIN. That is exactly the comparison I want to make between the chemical field and the other fields such as physics. Is there a similar situation, only to a lesser degree, as to the other fields of science such as physics? Where there would be interference by the Government moving in with its abstracting?

Dr. HUTCHISSON. In the field of physics our abstracting services are not nearly as well developed as those in the field of chemistry. Yet we are, through our own efforts, bringing about many improvements and we hope to have these continue. On occasion we may want to go to some agency, if possible, to get funds to assist us in improving them still further.

Senator MARTIN. In developing them still further by your own efforts?

Dr. HUTCHISSON. That is right.

Senator MARTIN. The only point I want to develop here is that any moving into the field of abstracting must be done with extreme care on the part of the Government.

Dr. HUTCHISSON. That is right.

Senator MARTIN. How we approach the matter, especially if we attempt to federalize any such service.

Dr. HUTCHISSON. There are many activities in which the abstracting journals join together to help themselves out. I spoke initially about my relationship with the International Abstracting Board of the International Council of Scientific Unions. This is a Board which is set up in order to help the abstracting journals throughout the world get better coverage of the scientific literature and to publish abstracts more quickly. This is a cooperative effort between the American journals of abstracting, the British journals, the German journals, and the French journals.

At the present time, at some of our International Abstracting Board meetings, we have had representatives from the Soviet Union attend. These meetings with groups of different nationalities getting together, all interested in the common problem of making scientific information better known and better distributed are very helpful.

Senator MARTIN. Then your position as to the Government's role here is not too far different from that of the chemists?

Dr. HUTCHISSON. I think that is correct.

Senator MARTIN. You have a little further to go to catch up with them, but you want to do it much the same way as they have done.

Dr. HUTCHISSON. We would like to do that, yes, sir.

Senator MARTIN. That is all.

Senator HUMPHREY. Thank you very much, Dr. Hutchisson.

We are very grateful to you. Thank you for coming to help us.

Dr. HUTCHISSON. Thank you, sir.

Senator HUMPHREY. We now have some witnesses from the National Academy of Sciences—National Research Council: Dr. Frederick D. Rossini, member of National Academy of Sciences; professor of chemistry, Carnegie Institute of Technology, Pittsburgh; chairman, division of chemistry and chemical technology of the National Research Council.

Also Mr. Charles I. Campbell, Rockefeller Institute, New York City, chairman of the program committee for the International Conference on Scientific Information to be held next autumn jointly by the NAS–NRC, the American Documentation Institute, and the National Science Foundation.

And Dr. Guy Waddington, Director of the Office of Critical Tables, NAS–NRC.

I gather that you might want to appear jointly. Is that the understanding?

Mr. ROSSINI. That is correct, sir.

Senator HUMPHREY. Whoever wishes to be the initial spokesman, proceed according to your own lights.

STATEMENTS OF DR. FREDERICK D. ROSSINI, MEMBER, NATIONAL ACADEMY OF SCIENCES; PROFESSOR OF CHEMISTRY, CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH; CHAIRMAN, DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY OF THE NATIONAL RESEARCH COUNCIL; ACCOMPANIED BY CHARLES I. CAMPBELL, ROCKEFELLER INSTITUTE, NEW YORK, N. Y., CHAIRMAN, PROGRAM COMMITTEE FOR THE INTERNATIONAL CONFERENCE ON SCIENTIFIC INFORMATION TO BE HELD NEXT AUTUMN JOINTLY BY THE NAS–NRC, THE AMERICAN DOCUMENTATION INSTITUTE, AND THE NATIONAL SCIENCE FOUNDATION; AND DR. GUY WADDINGTON, DIRECTOR OF THE OFFICE OF CRITICAL TABLES, NAS–NRC

Dr. ROSSINI. Thank you. I am Professor Rossini and I would like the privilege of describing what the National Academy of Sciences—National Research Council has done in the field of information and documentation in science and what it is presently concerned with in this area.

Ever since the National Academy of Sciences was founded in 1863 it has had a very deep concern about information, and this came very much to the fore at the time of World War I when there was founded the National Research Council to be the instrument through which the aims and efforts of scientists generally could be associated with those of the National Academy of Sciences.

Senator HUMPHREY. Doctor Rossini, before you proceed further: Do you have any additional copies of your statement?

Dr. ROSSINI. I am sorry, Mr. Chairman, this is going to be an off-the-cuff presentation, because I have not had the opportunity to present a formal statement.

Senator HUMPHREY. We are pleased that you are here. You proceed and we will listen attentively.

Dr. ROSSINI. Historically the National Research Council, under which the National Academy of Sciences does most of its operations in the field of information and documentation in science, began one of its biggest projects shortly after World War I by the establishment on an international basis of the international critical tables. This came about through authorization by the International Union of Pure and Applied Chemistry, at a meeting held in London in 1919; of an international project called the international critical tables of numerical data of chemistry, physics, and technology.

The union agreed at that meeting to assign the financial responsibility and the editorial responsibility for this new project to the United States of America, and later the International Research Council gave its patronage to this project.

For the United States the National Academy of Sciences, through the National Research Council, accepted the executive, financial, and editorial responsibilities of this project which actually got under way in 1920.

With the cooperation of the American Chemical Society and the American Physical Society, the National Research Council created a board of trustees to take charge of the financial and business administration of the enterprise, and a board of editors to supervise the preparation of the text for these international critical tables.

About $200,000 was collected from industrial firms and individuals, largely from the United States, to finance this undertaking. In the years 1926 to 1930, seven volumes were produced.

The entire project had a large number of collaborators in many organizations in a dozen different countries, but all the details of the management and editorial work were accomplished in the National Research Council through the late Dr. Edward W. Washburn who served as editor in chief.

The board of trustees of the International Critical Tables had hoped that they would become a continuing established institution, so that these tables of numerical data, so necessary for basic research in the fields of chemistry, physics and engineering, would be continued. But unfortunately the financial situation in the early thirties was not such as to make possible the continuance of these tables, and a lapse occurred.

Meanwhile, the need for this particular form of scientific information which I am describing as "continuing critical tables" became very pressing and several years ago the National Academy of Sciences—National Research Council authorized a new Office of Critical Tables to be established, with the object of accomplishing something concrete in this area.

Senator HUMPHREY. Doctor, what do you mean by "critical tables"? I am just a layman here; this is one of the problems of representative government. Would you help me a little?

Dr. ROSSINI. The definition of what I would call "continuing critical tables" is tables of numerical data pertaining to physical and chemical and engineering properties of substances selected in a critical way and put up in tabulated form for the use of scientific and technical people in these fields. These data are obtained from the original literature by careful search and appraisal and then put into this final

tabulated form by competent scientists. This is one of the very special and costly forms of documentation in the sense that much effort has to go into producing small quantities of it.

Senator HUMPHREY. This would be very valuable for basic research in particular, would it?

Dr. ROSSINI. In particular for basic research but also for applied and engineering research.

Several things have happened since the original international critical tables came out 30 years ago. I briefly mention them. Science and engineering now have areas that never existed before, and these areas require new compilations of data.

The previously known fields of science and engineering have expanded greatly in size, requiring far more data than before.

The precision of measurement in science and the precision of manufacturing in industry have been pushed to another magnitude necessitating more accurate data than were heretofore available.

Looking at the present picture, if the international critical tables of 35 years ago cost $200,000, we may make a rough estimate that a modern version of that operation would cost approximately $20 million. Obviously this is not very practical. As an alternative we have established in the National Research Council an Office of Critical Tables which will not do any compiling as such, but will take advantage of a number of existing critical compiling projects and will coordinate these and to also encourage the establishment of similar ones. That is the total task will be accomplished by breaking it down into small portions each one of which will be carried out by the most competent specialists in appropriate scientific institutions. Through an appropriate advisory board and executive committee this new Office of Critical Tables actually got under way last fall with the appointment of my associate, Dr. Guy Waddington, who is on my right, as the director. Its purposes may be listed under 5 points.

(1) To survey the needs of science and industry for these critical tables of numerical data in physics, chemistry, and engineering;

(2) To stimulate and encourage existing compiling projects in these areas;

(3) To assist in the establishment of needed data compiling projects for new scientific areas in responsible institutions, manned by qualified persons with financial support provided by appropriate organizations interested in the data;

(4) To promote uniform editorial policies and procedures and to promote high standards of quality;

(5) To provide a continuing central indexing and directory service covering all existing data projects, with the thought that this work would make these projects much more useful to all science and industry in our country.

I have taken the time to outline one facet of the work of the National Research Council in one area of information in the field of science, to illustrate the line of thinking which involves using the Council as a coordinating agency to take advantage of all the work now going on in this area by scientists dedicated to work in those areas, in institutions which are interested in having that work carried on, and supported by organizations, including Government, that might be interested in having data for special needs.

Senator HUMPHREY. The Office of Critical Tables is not what you would call an operations office as such but a staff office or coordinating office; it is what we talked of in the broader dimensions here as the catalytic agent, so to speak, a leader giving some pilot project guidance and assistance; is that the idea?

Dr. ROSSINI. That is correct.

With that detail on the one operation which began nearly 40 years ago and which has now taken a new form as of a year or so ago because of the changed conditions, and which now has this form that you have described, serving as a coordinating agency and a catalyst and a promoter and encourager, I would like briefly to mention the breadth of the interest in the National Academy of Sciences—National Research Council, in this whole area.

We have operating in the National Research Council another office called the Prevention of Deterioration Center. This office assists the United States Department of Defense and other authorized agencies who are interested in combating the impairment and deterioration of materials and equipment. This office provides information, abstracts, and advisory service in that area to these agencies who are the primary supporters, and to any other Government agencies and to the public on request.

Another office is the Toxicological Information Center. This serves as a clearinghouse and source of toxicological data and interpretations thereof for the United States Department of Defense and the United States Atomic Energy Commission.

Senator HUMPHREY. Is that its only function?

Dr. ROSSINI. Primarily. I think they would, in nonclassified areas, in which most of their work occurs, be very glad to provide information in general.

Senator HUMPHREY. Does that office have a central indexing system and so forth on all toxicological materials?

Dr. ROSSINI. It has a small staff of about five people only, but it is believed to have in this area a rather complete grasp of the recorded information in this area.

Senator HUMPHREY. And knows where it is?

Dr. ROSSINI. Yes, sir.

Now, a final brief statement about the other interests of the National Research Council that relate to this general problem of scientific information. These cover many disciplines of science.

We have in our Division of Anthropology and Psychology a committee on primary records.

In the Division of Biology and Agriculture we work on handbooks of biological data and handbooks on laboratory animals.

In the Division of Chemistry and Chemical Technology, we have a project on tables of kinetics of chemical reactions.

In the Division of Earth Sciences, we sponsor geological abstracts.

In the Division of Mathematics, we sponsor a journal of mathematical tables.

In the Division of Medical Sciences, we produce a bibliography of cardiovascular literature and an atlas of tumor pathology.

In the Division of Physical Sciences, we prepare nuclear data, spectral absorption data, and related chemical and physical data.

And finally, until recently there was in existence for about a dozen years a Chemical-Biological Coordination Center which had the

function of collecting and coordinating information in the field of biologically important substances.

Senator HUMPHREY. What happened to that?

Dr. ROSSINI. That office had to be discontinued this year because of lack of supporting funds.

I wish to report next on a request which came to the National Academy of Sciences—National Research Council, recently from the Council on Documentation Research which met in Cleveland under the auspices of Western Reserve University several months ago. This request asked that the Academy-Research Council—

(*a*) Study the entire problem of the handling and documentation of scientific information; and

(*b*) Make recommendations for the problem on a national scale.

On March 31, some weeks after the receipt of that request, there transpired a one-afternoon "workshop" during the course of the 1958 annual meeting of the National Research Council. This particular workshop was concerned with information and documentation in science.

As one of the assignments of that afternoon's discussion there was given to the group to study the request which had come to the Academy-Council from the Council on Documentation Research. The consensus of the group studying the request was that the problem of information and documentation in science is indeed significant both nationally and internationally, and one which the Academy-Council clearly has responsibility to consider.

The same group noted that while the problem needs urgent attention, our understanding of the total needs and resources is not sufficient today and will likely not be in the immediate future, to warrant establishment of a national information center on a crash basis.

Certain recommendations were made. These recommendations were later approved by the governing board of the National Academy of Sciences—National Research Council, at a meeting on April 27, just past. They take the form of eight points.

(1) That the Academy-Council should establish an advisory board on information and documentation in science, with members of high competence, including both scientists and information specialists to prepare a plan for effective action on the problem.

(2) This advisory board should have a small full-time professional staff to assist the board in carrying out its study.

(3) The advisory board should scrutinize the national and international problems in this field on a general policy level.

(4) The advisory board should make a survey and assessment of the knowledge now available and of the work in progress.

(5) The advisory board should prepare a plan for the coordination, by appropriate agencies, of the many activities now being carried on in this field under the auspices of the Academy Council and also elsewhere in our country.

(6) The advisory board should address itself to certain concrete and immediate problems, including assistance to the Office of Scientific Information of the National Science Foundation, the assessment of proposals for research undertakings in this field, the identification of areas where new knowledge is needed, and so forth.

(7) The Advisory Board should effect liaison in its study among the several committees and groups now studying this general problem, in-

cluding the Committee on Information in the office of Dr. Killian, science adviser to the President, the Federation of Abstracting and Indexing Service, and so forth.

(8) The Advisory Board should prepare a plan for an information center on the subject of information and documentation in science.

Senator HUMPHREY. When you say "Advisory Board," Dr. Rossini, you are talking about an advisory board to the National Academy of Sciences?

Dr. ROSSINI. Yes, sir.

Senator HUMPHREY. National Research Council?

Dr. ROSSINI. Right.

Senator HUMPHREY. Again, just so that I may understand this properly, the National Research Council is an adjunct to the National Academy of Sciences; is that right?

Dr. ROSSINI. That is correct, sir.

Senator HUMPHREY. And these eight recommendations are the result of action on the part of your governing board in response to a request that was made by the group that met under the auspices of Western Reserve University; is that correct?

Dr. ROSSINI. Yes, sir.

Senator HUMPHREY. And what you just read are the recommendations of the governing board of the National Academy of Sciences and the National Research Council; is that correct?

Dr. ROSSINI. That is correct. And by approving these they have assumed responsibility to proceed according to this outline.

Senator HUMPHREY. And the result of this study that you have hereby recommended will be the response to the Western Reserve University proposal and request; is that correct?

Dr. ROSSINI. That is correct.

Senator HUMPHREY. How long do you think it will take to be able to give the Western Reserve University coordination group——

Dr. ROSSINI. It depends on documentation research.

Senator HUMPHREY. How long will it be before you will have something to offer them?

Dr. ROSSINI. I don't know, Mr. Chairman. I think the Academy Council would be desirous of proceeding on this important problem as expeditiously as possible, but it is going to depend upon the availability of funds to support the study and the availability of the right people to do the work.

Senator HUMPHREY. We are getting down to where again we might talk in some specifics. Surely we wouldn't want to duplicate efforts now being made to deal with the existing situation. The National Academy of Sciences has a unique roll in the scientific community. It is more or less the parent organization, is it not, of all the disciplines and sciences?

Dr. ROSSINI. Yes, Mr. Chairman. The Academy Council has a unique role in the sense that it is in a position representing all sciences where it can effect easily and on a very high level coordination among them. This it looks upon as a prime obligation under its original charter, which is to engage in the furtherance of science for the general welfare of the people of the United States of America.

Senator HUMPHREY. The Academy was established by charter from Congress; is that correct?

Dr. ROSSINI. Yes, sir.

Senator HUMPHREY. So that while you have private responsibilities, you also have, by the nature of your charter, some public responsibilities, and have been called upon by the Government to be of considerable help at all times; isn't that true?

Dr. ROSSINI. That is true. One of the Academy's prime functions is to serve as an adviser to the Government on scientific matters.

Senator HUMPHREY. This is where I am beginning to wonder if it wouldn't be possible for the Government, in cooperation with the Academy of Sciences, in light of the recommendations which you have just expounded here, to be of some assistance in getting this project underway. I don't see any reason that we should have a Government research job going on in this field and then somebody else over here doing it, when there is a coordinating group in existence already.

It appears to me that there may be some way that some one of the agencies or departments of government, the National Science Foundation or the Department of Commerce or the Office of Technical Services could develop solutions to many of the problems that have been outlined during the hearings.

What I am getting at is that every one of these agencies can be of some help in terms of financing or cooperation. What is your feeling about that?

Dr. ROSSINI. I think that would be very much in order. I think one of the first things that Dr. Bronk, the President of the National Academy of Sciences, would want to do after setting up the Advisory Board which is to undertake this study, would be to arrange some way for the funds necessary to finance the undertaking.

Senator HUMPHREY. Dr. Killian is the President's adviser on scientific matters now. He has a subcommittee of the Killian Committee working on the same area that your advisory group is about to direct its attention to. So we Americans really know how to create these arencies. What I am getting at is would it not be possible for your advisory group to have some contact with that subcommittee and maybe have Dr. Killian make some recommendation as the Presidential adviser, as to how the Federal Government might properly participate?

Dr. ROSSINI. I am sure that this would be one of the avenues that would be explored. I want to add to your statement that there is close contact among these committees already, and the purpose would be to effect even closer liaison and collaboration among them. For example, the Chairman of Killian's committee on the information problem is Dr. Waterman, the Director of the National Science Foundation, and, of course, Dr. Bronk is presently Chairman of the National Science Board.

So there is a very close connection among the people who would be concerned with the overall decision making in this area.

Senator HUMPHREY. This is good to have in the record so that the layman or the student who may read this testimony understands that these many committees and subcommittees and boards are not just separate and distinct compartmentalized operations, that there is this capillary structure which holds them together. Board members turn up to be chairmen of another group, and the chairman turns up to be an adviser of a third group. It is like aristocracy intermarrying.

Dr. ROSSINI. I would like to mention one other prime concern of the Academy Council. I mentioned, for example, that it embraces all the disciplines of science in our own country on a national scale.

It has an equally important task with respect to our interests in science on an international scale. The Academy Council maintains connections with many international unions in chemistry and physics, astronomy, mathematics, et cetera. But in the field of information and documentation of science it has an immediate present special concern through what is now going on in the arrangement for a 1958 International Conference on Scientific Information. My associate, Mr. Charles Campbell, on my left, is chairman of the program committee for that Conference which is to take place in November of this year. I would like your permission to have him briefly tell you about that international conference.

Senator HUMPHREY. Please go ahead, Mr. Campbell.

Mr. CAMPBELL. I am one of those Johnnies-come-lately in this field, as you can tell just by looking at me. Even in connection with this conference, I am a Johnny-come-lately.

There are many in this room who had much to do with the beginning of the idea of an international conference which will be a kind of research conference on the storage and retrieval of scientific information. A conference of wider scope also on an international scale was held about 10 years ago by the Royal Society in England, and in a certain sense this is the first conference on that scale to be held since—10 years later.

We have enjoyed the cooperation of the Royal Society, the International Federation of Documentation, UNESCO, the National Science Foundation, and a number of both national and international groups who are interested in this whole problem of information.

I myself have had the job of organizing, and finding, selecting, and currently publishing the papers that will be presented at this conference. I think it is of interest to know how difficult it has been to find good research papers on the subject of the storage and retrieval of information.

In the fields of the sciences, in physics and chemistry and biology and so on, the big problem is how to publish all of the good information that is at hand. With regard to this international conference, the situation is quite different. It is how to find good information. If we can find it, it is easy to publish it.

Senator HUMPHREY. Do you mean how to find good information that will make good information available to people who need good information?

Mr. CAMPBELL. Exactly.

We are trying to find the beginning for the beginning of the beginning.

Senator HUMPHREY. Yes, sir.

Mr. CAMPBELL. Indeed this is the essence of the problem of the international conference. The first area to be considered by the conference is how to determine the needs of scientists for information. We don't know how scientists use information. The kind of information they need is a function of the level in research at which they stand, the kind of research in which they are engaged, whether engaged in basic or applied research, in engineering, aeronautics, or astronomy.

The second and third areas of the conference discussion concern how to determine the adequacy of what they now have in the way of information systems.

I think no one knows or can prove that he knows how to prove the adequacy of any indexing or abstracting service. We all have a conviction that chemical abstracts is a very fine service, but we can't prove it in the same way that we can prove that the uranium atom is fissioned by a thermal neutron. It is a quite different kind of problem. It is not a scientific discipline. It is an economic and social conviction that our abstract services are good.

We don't know how to design them in terms of our specific needs. So the second and third areas of the conference are directed to this question, the adequacy of indexes, abstracts, monographs, books, specialized information centers, handbooks, tables of critical data. How do you assess the adequacy of these tools for organizing and using scientific information?

The fourth area of the conference discussions will concern the question of comparings, on some kind of rational basis, two different systems for storing and retrieving information. Some systems can store a great deal of information, but it takes a long time to find it. Others can store relatively little but they can get it instantly. What rational basis is there for comparing such extremely different systems as a pile of edge-notched punched cards and an IBM 705 computer?

The fifth area of the conference will concern the question of the design of systems in terms of specific needs. And you see already here there is something illogical. We assume that we know the needs and that the problem is to design a system to meet them. We do have ideas about the needs, but we don't really know.

The sixth area of the conference will concern the question of the theory of storing and retrieving information. Is it possible to treat this subject in theoretical, mathematical abstract terms that may be not only beautiful mathematically but useful in a practical way just as theoretical physics is beautiful but also very practical at Eniwetok?

Finally, the seventh area which is perhaps closest to our concern here, today, is who is responsible to support and carry on research and operations in the field of scientific information? It is the university? The Government? Industry? The professional societies? All of them severally? And how do they divide those responsibilities?

This is the substance of the kind of question that has been put to the world by the National Academy of Sciences and the American Documentation Institute and the National Science Foundation in a world forum addressed to this whole question.

We have been in active communication with something like 700 or 800 people over the past 2½ or 3 years as to whether they may be carrying on work which will eventuate in a research paper or contribution to the conference.

Finally, after our deadline for receiving papers, February 3 of this year, we have received something like 150 papers. I think it is an interesting sidelight on human nature, that as of our deadline we had only one paper. But now we have 150.

Senator HUMPHREY. I feel so normal. I thought you scientists had everything worked out so that all these deadlines were met. Now I feel as though I am almost scientific.

Mr. CAMPBELL. I don't want to shake your complacency but I think part of the problem is that this field is not scientific; that the preparation of research papers on this subject is something we do at home or on weekends or when the boss is out of town. We are all

busy carrying on an operation. We are so busy operating our systems that we don't have time to think about them.

There are certainly notable exceptions, many of whom are behind me in this room, whose principal interest is the analysis of the problem, research, and development on this problem of storing and retrieving information. But so many of the papers have come in after our being in correspondence with someone for 2 years, with the statement, "I am very sorry but I was going to do this on my vacation last summer, and I had another job to do, and I won't have time to do it this summer; this is the best I can do." It touches the problem of who is responsible for research on this problem.

I should go on and add that out of the 150 papers we now have, we have found acceptable about half of them. And about half of those are from this country and the other half are from abroad, scattered over India, Sweden, Finland, England, France, Italy, and other countries. These will be gathered together, published, and distributed in advance to all those who are registered for the conference. Then they will be discussed during the week-long conference in November here in Washington—November 16 to 22 of this year.

The papers will be discussed by panels of experts and scientists as well as documentation people, under the chairmanship of distinguished individuals. Dr. Hutchisson, who just left, will be the chairman of one of our panels.

Out of all this we hope will come a clearer picture of what we know, what we don't know, what we need to find out, and how we may go about finding it out.

Senator LAUSCHE. And finally, what to do?

Mr. CAMPBELL. And finally what to do.

Senator HUMPHREY. The findings of your meeting will be made available then to the advisory group of the National Academy of Sciences—National Research Council?

Mr. CAMPBELL. Yes, sir.

Senator HUMPHREY. So these are all more or less dovetailed together?

Mr. CAMPBELL. Yes, sir.

Senator HUMPHREY. You have the Council on Documentation doing its work, many private and specialized societies doing their work, and you have this advisory board that has been established now by the order of the governing board, and then your international conference is going on as a parallel operation which will feed in its information into the advisory group; is that correct?

Mr. CAMPBELL. That is correct except that the governing board has only approved setting up an advisory board; it has not yet been set up.

Senator HUMPHREY. When is this conference?

Mr. CAMPBELL. November of this year—November 16 to 22.

Senator HUMPHREY. Did the launching of sputnik have anything to do with this sudden outbreak of interest in this particular field?

Mr. CAMPBELL. This particular conference was launched about 3 years ago. We were deeply in it before we knew about sputnik. And though there are some who think there is a close correlation between sputnik and interest in this field, I can't see why myself.

Senator HUMPHREY. I think this is good to have for the record, too, because it seems as if many people try to ascertain the genesis of many good ideas that are now underway by the event that took place

in the first week of October 1957. In fact, the American scientific community has been preparing this type of study for some time, as have other scientific communities. That is a correct statement; isn't it?

Mr. CAMPBELL. That is correct. And it was perhaps 2 years ago that the director of the Soviet Scientific Information Institute visited us to find out what we were doing. I daresay he went home and told his colleagues that we were ahead of them and that therefore they must work much harder.

Senator HUMPHREY. There is nothing like competition.

Mr. CAMPBELL. There is nothing like competition; yes, sir.

Senator HUMPHREY. I can predict that the conference will be a good one. You have given us a most logical, cogent, and concise presentation. I see that you are chairman of the program committee?

Mr. CAMPBELL. Yes, sir.

Senator HUMPHREY. It will be a real program.

Mr. CAMPBELL. We hope so.

Senator HUMPHREY. It will. No doubt about that. I hope that some of us laymen may be able to sneak in and see what is going on. That is in November?

Mr. CAMPBELL. Yes, sir.

Mr. REYNOLDS. Particularly the staff.

Senator HUMPHREY. Particularly the staff. Where will that be?

Mr. CAMPBELL. The headquarters is the Mayflower Hotel.

Senator HUMPHREY. I thought this was going to be away someplace.

Mr. CAMPBELL. It is our only serious blunder so far.

Senator HUMPHREY. Senator Thurmond?

Senator THURMOND. I have no questions.

Senator HUMPHREY. Senator Lausche?

Senator LAUSCHE. I have none.

Senator HUMPHREY. Senator Martin?

Senator MARTIN. I am bothered a little bit about how fast this committee should move in trying to solve your problem before you proceed further with your own analysis and study of it in the meeting that you have planned for next November. What is your opinion about this legislation before us now, as to the matter of the speed of our approach to it, setting up some kind of a program here that is just a little beyond my comprehension?

I would not be a good judge as to how far to go in any legislative approach. Would you invite us to make all speed ahead on certain parts of this program now under study here in this committee, or would you wish to go through the proposed program and pick out parts of it that you think it would be well for us to use as a starting point?

Mr. CAMPBELL. That is a very big question.

Senator MARTIN. It is, and it bothers me. I cannot imagine myself as capable to outline a program that will fit exactly what you have described here in your approach to the whole field of science that is in your jurisdiction when I have as little knowledge as I have in the field of science.

Mr. CAMPBELL. I think perhaps I should say one thing in clarification of the nature of this conference, if I may. It is, after all, only 1 conference, and it is only 1 week. Research in this field has been carried on since—who knows—the time of Aristotle. Perhaps not at

the level of intensity we would like. Papers are being published continuously.

Dean Shera is the editor of a journal publishing research papers in this field. There is another published internationally. Government agencies are making it possible for us to see research reports of their own work. It is not as if something were going to happen in November which had never happened before and would not happen again.

Moreover, it is not our aim to arrive at formal conclusions at this conference, any more than the American Physical Society at the conclusion of one of its annual meetings votes whether it is for or against a new scientific discovery. It is a forum for discussion. And therefore its result will not be perhaps as tangibly relevant to your concern here as you might expect and hope.

I think that is a roundabout way of saying that I wouldn't wait for this conference before you take action.

Senator MARTIN. That is a very good suggestion coming from you with your background. We need that information. We also need to develop here a general approach that will not be too detailed, not attempt to delineate the exact limits of your efforts or the efforts of scientists generally, and only to help you in any way we can without imposing Government control of your whole activity in the form of an authoritative body to tell you what to do and when to do it.

I am very much opposed to Government taking over and becoming a master and directing group. On the other hand, I want the Government to be helpful. Just where to apply our help is my problem.

The matter of documentation and abstracting and cataloging and indexing is so varied in different fields, according to the testimony here, that we will have to be a little careful as to how we move into specific areas lest we do some damage in our efforts to do good.

If you, as a representative of the great National Academy, can outline a little more specifically for us just where you think we should try to move in this proposal that is before us as a committee, I would appreciate any comment you have to make on that.

Mr. CAMPBELL. I would like to take this opportunity to comment on how effective I regard the help that the Government is already giving this field in the form of research contracts from the National Science Foundation, the Air Force, the Office of Naval Research, and others, to carry on research in this field. Many of the really fine papers we have for our conference are the result of specific contract support from the Government in this way.

I see a certain parallel, though I am not intimately familiar with its operation, between what might be possible here and what prevails in the field of the aeronautical industry and the relationship between the NACA—National Advisory Committee for Aeronautics—and the operating problems in the construction and operation of aircraft.

The NACA is not only an advisory organization but it is a research organization which carries on a kind of research which is everybody's business and nobody's business in the field of aeronautical engineering and design. It is a Government organization. The results of its work feed into the whole aeronautical industry here and abroad.

In the same way perhaps there are possibilities for carrying on research in this field of documentation which is really not primarily the problem of the Patent Office, for example, or the National Institutes of Health, or in a sense the American Physical Society or the

other scientific societies. These are people whose care is the scientific production in their own fields. Yet they all depend on improvements in our knowledge on how to handle information as information, not as chemistry, not as physics, not as astronomy.

Perhaps it is because it is everybody's business and nobody's business that the field has been lagging.

I think that is as far as I can go in saying anything that I would regard as useful.

Senator MARTIN. Thank you.

Senator LAUSCHE. Dr. Rossini, you advised against the adoption of any crash program not adequately thought out in trying to solve the problem which we are discussing; is that correct?

Dr. ROSSINI. That is the position which the governing board of the National Academy of Sciences-National Research Council has taken, and one which I, personally, also would take.

Senator LAUSCHE. Would you describe in greater detail the connotation of those terms, that you advise against the adoption of a crash program?

Dr. ROSSINI. Quoting again from our report, I would say that we strongly feel that this problem needs attention urgently, but at the same time we feel that our understanding of what the total needs are and of what the actual resources are at the present time is not sufficient and likely will not be in the immediate near future to permit us to go ahead and establish such a national information center on any real lasting basis.

Senator LAUSCHE. Am I correct in my understanding that from your standpoint and from the standpoint of those who are associated with you, you are not now in a position to suggest to us what the Federal Government's participation ought to be at this time without further study?

Dr. ROSSINI. That is correct, sir.

Senator LAUSCHE. Would you be prepared to express an opinion whether the Federal Government ought to get into the operational field in the gathering of the information on indexing and documentation and cataloging and so forth?

Dr. ROSSINI. I haven't had an opportunity to think out that phase of the problem, but I would on the spot be inclined to say that we should first take advantage of all of the existing operations in this area, to do everything we can to make the good that is in them better, and to expand them within the limits of their capabilities, and then to assess other areas not now covered where work is needed and do whatever is necessary to effect work getting started in those areas.

Senator LAUSCHE. Mr. Campbell, you described your conversation with a representative of the Soviets who came here to make inquiry about the condition that exists in our country with respect to the development of this subject we are discussing. You said that when he left you are certain that he did so under the conviction that we were far advanced in this field over that of the Soviet government; is that correct?

Mr. CAMPBELL. When I hear you say what I said, I realize I said more than I knew.

Senator LAUSCHE. Am I correct in the inference which I drew from what he said?

Mr. CAMPBELL. May I amplify on my statement a bit?

Senator LAUSCHE. Yes; I wish you would.

Mr. CAMPBELL. The individual was Dr. Panoff, who was at that time the director of the All-Union Institute of Scientific and Technical Information of the Soviet Academy. Perhaps it would be oversimplifying to say that his organization seemed to me to have been established to try to do as well in the U. S. S. R. as Dr. Crane and several others had been doing for a long time in this country. Their main function was to organize a centralized system of abstracting service for world, but primarily Soviet, technical literature.

It seems to me a reasonable thing to do because the time had come when the Soviet Union was no longer depending primarily, apparently, on our literature. They were depending on their own. And their own security restrictions had apparently relaxed enough so that it made sense to publish and circulate information about what was going on. They were willing to say enough about what they were doing, even to themselves, so that they would need an abstract service.

Dr. Panoff's visit here, I believe, was primarily in connection with a conference at MIT on mechanical translating. He came here to Washington as a guest of the Academy to talk with us about our plans for the International Conference on Scientific Information. And indeed the Soviets are making two contributions to the Conference.

While he was here he visited the Chemical Biological Coordination Center, which you heard of briefly from Dr. Rossini. In looking at their work he was astonished and delighted to see that they had a code for dealing with chemical information in the CBCC, which Dr. Panoff said they in the Soviet Union hadn't begun to devise, but which he recognized they would soon need.

Senator LAUSCHE. May I interrupt? He, in a measure, conceded that from the standpoint of the chemical science, our indexing excels that which they have in the Soviet; is that correct?

Mr. CAMPBELL. I think that is correct; yes, sir.

Senator LAUSCHE. Do you know of any field in which you can say with any degree of certainty that they excell the work that we have done in the development of this method of supplying information?

Mr. CAMPBELL. Yes.

Senator LAUSCHE. We would like to know it.

Mr. CAMPBELL. I believe they know a great deal more than we know now about how to translate from one language into another mechanically, or with a computer. This I know only by hearsay because it is not a field that I understand myself. But the examples of the work which they brought here 2 years ago to the conference I described, I understand were impressive.

Senator LAUSCHE. That is on the matter of mechanical translation?

Mr. CAMPBELL. Right.

Senator LAUSCHE. Dr. Crane made the statement yesterday that the inference was justified that since we excelled them in great degree with the index we have on chemistry, that in all probability we excel them on indexing and documentation in the other sciences. May I have your opion on that statement?

Mr. CAMPBELL. It seems reasonable to me. I believe they are Johnnies-come-lately in this field, to use Dean Shera's term again.

Senator LAUSCHE. Somewhere in one of the reports great stress

has been laid upon the fact that somewhere in our scientific research, either on basic information or on application, we spent a couple of hundred thousand dollars in developing something that was already in the literature which the Russians had issued. Would you give your evaluation of that incident, if you can?

Mr. CAMPBELL. I saw a note about that this morning, but I don't know anything about it myself. The note I saw was in the analysis prepared for your committee.

Senator LAUSCHE. Does that seem to be something that is profoundly shocking and sort of miraculous, that we didn't have it, that it wasn't discovered?

Mr. CAMPBELL. I am not shaken by the fact.

Senator LAUSCHE. Dr. Rossini?

Dr. ROSSINI. I think one could say that in many of these things you do want a little overlapping, because in addition to getting the end result you are acquiring a very valuable experience just in doing the job. So a certain amount of that is always desirable. The big problem is to avoid letting that sort of thing get out of hand.

Senator LAUSCHE. Maybe I am entering into a difficult field. But my understanding of the philosophy of teaching in our public schools is not to believe anything except after you have made your personal research and experimentation to determine the truth. Does that have a relationship to what you have just said, that it is pretty good to do your own investigating?

Dr. ROSSINI. I wouldn't want to carry it that far, because all I am saying is that in the conduct of scientific research it becomes desirable for an investigator to learn various techniques, apart from just reading the result in a certain case.

Senator LAUSCHE. The point I am trying to make is that frequently we hit upon some isolated instance and use it as an illustration of general habits and approach, and that isn't sound, of course.

Dr. ROSSINI. I agree with you on that 100 percent.

Senator HUMPHREY. Dr. Rossini, may I ask you this question:

Do you feel that the Federal Government has any role that it can play at all at this particular time, over and beyond what it is presently doing, by the contract type of service, that would be helpful to your advisory council?

Dr. ROSSINI. I believe that the Government can provide support through an appropriate agency for this advisory board to carry on its work; secondly, I am sure that there is a continuing need for the support of researchers on all the qualified organizations now operating in the country, such as Western Reserve group for example, to do research on the methods and procedures of storing and retrieving information. This ought to be going on now so that we learn more about how these problems ought to be solved when we get the whole picture through the bringing together of as many minds, expert in this field, as we can, through the mechanism I indicated.

Senator HUMPHREY. In other words, would it be helpful to turn over the report and the testimony of these hearings, say to Dr. Killian's subcommittee, as a part of the general information which his organization may want to study? Possibly a copy of this testimony should be furnished to the respective Committees on Appropriations of the Congress, and to the National Science Foundation.

What I am getting at is that there may be somewhere in the present establishment from which a constructive recommendation can come, if there is adequate evidence presented as to the need and the possibility of some accomplishment. There may be come place where additional contracts could be issued for the kind of research you are talking about, and possibly the National Science Foundation, through a contract with the National Advisory Council could help to explore these problems in the most comprehensive manner.

Dr. ROSSINI. This, I would agree, is correct.

Senator LAUSCHE. Might I ask another question?

Senator HUMPHREY. Go right ahead.

Senator LAUSCHE. Do you know of any contracts that have been let by any governmental agency or quasi-governmental agency for the purpose of making research in the development of mechanical devices that will aid in the solving of this question

If you can't answer that, if there is anyone here who can, I would like to know.

Dr. ROSSINI. I can't answer that. Perhaps Dr. Burton Adkinson could do so.

Senator LAUSCHE. Dr. Adkinson?

Dr. ADKINSON. I am head of the Office of Scientific Information, National Science Foundation.

Yes, there are many contracts by governmental agencies in this field at the present time for the development of systems to use machines, and to handle information.

The National Science Foundation in cooperation with the Air Force, the Army, and many other agencies, have let contracts for research in mechanical translations. There are not just a few dollars but hundreds of thousands of dollars let on contracts in this field.

Senator LAUSCHE. Now I would like to hear from Mr. Perry.

Mr. PERRY. I am J. W. Perry, Western Reserve University.

Perhaps the amounts are of some significance. We had, if I remember rightly, with the Air Force, a contract that amounted to about $20,000 in the past. We have one that is now going on of about $25,000 in the field of documentation research. We have had one contract with the National Science Foundation that amounts to $35,000. That is since March 1955.

Senator HUMPHREY. Senator Lausche, I call the attention of members of the subcommittee to page 35 of the staff report, Document No. 90, which notes that there was a meeting of officials representing Federal agencies engaged in assembling, translating, abstracting, and disseminating Russian scientific information for the Federal Government, held last October.

It was agreed by these agencies that the Office of Technical Services of the Department of Commerce would be the central coordinating agency, and that request was made of the Congress for a supplemental appropriation for $300,000, which was rejected.

The report quotes from the report of the House Committee on Appropriations as to why these funds were not provided, as follows:

> The committee has not included this item in the supplemental bill. Funds for this purpose are also requested in the regular 1959 budget, and the committee expects to consider this matter further during the hearings on that estimate.

This is related to a very specific project, the matter of reproducing and distributing scientific Russian-language translations which have

been completed by certain agencies for their own information, but which agencies have no funds to cover the cost of general distribution to scientists and other who might make use of it.

What I am getting at by this reference is that it might be possible, in view of the proposal laid before us from the governing board of the National Academy of Science, for the Bureau of the Budget, as well as the Office of Technical Services, and all the other Federal agencies that are interested in this whole problem, to join forces and make recommendations to the appropriate committees of Congress that we enlist the service of your advisory group on a contract basis, through, let us say, the Office of Technical Services, or through the National Science Foundation.

This wouldn't mean that that would be all that would be done, but I think these projects in limited areas ought to be carried on, too.

I thoroughly agree with Senator Martin when he said a while ago that this is beyond our competence. It seems to me that we would be very wisely counseled if we would proceed prudently and cautiously on this by permitting an agency or instrumentality such as you have outlined, the National Academy of Sciences, to go into this for us and for the executive branch and for the whole area of science. This is my personal momentary reflection on it.

Would this be of help to you?

Dr. ROSSINI. I think that Dr. Bronk, as president of the Academy, would be very glad to have cooperation of this sort on this problem that has been put before him.

Senator HUMPHREY. If there are no further questions, I think we will move along to hear the next witness that we have, who is Mr. Baker. We surely want to hear from him. This afternoon we are going to come back at 2:30. Would that be agreeable?

Mr. Baker, we will start with you.

Mr. Baker is the vice president of research, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Mr. Baker has been referred to on several occasions in these hearings always with favor and credit.

STATEMENT OF W. O. BAKER, VICE PRESIDENT—RESEARCH, BELL TELEPHONE LABORATORIES, INC., MURRAY HILL, N. J.

Mr. BAKER. I shall try to be very economical of your time in trying to represent the position of an industrial scientific worker.

In industry, of course, as elsewhere in other activities, we feel that science is a dualism of new discovery and novel description on the one hand, but on the other the whole structure of knowledge and hypothesis which came before. Accordingly, unlike the arts, in which a composition of poetry, music or sculpture may be a self-contained achievement, we find in industry as elsewhere that progress in science and technology is significant only in relation to prior work.

Thus, the recording, indexing, and accessibility of scientific information become very central.

Indeed, industry is more heavily dependent than universities or the Government, it seems to us, on this recorded knowledge, because industry's intimate linkage between science and technology, and actual operations means that decisions which are evaluated without respect to previous experience, previous literature, or to the previous record,

may quickly be converted into results of damaging redundancy or inadequacy.

Accordingly, we are deeply concerned with the efficient use of the scientific and technical literature but customarily frustrated by our own deficiencies in dealing with the monstrous volume of this literature.

It is a rather interesting reflection on the volume to see that in your provisions here and in related information there are serious and respectable estimates, in one case of 10,000 existing scientific journals, and in another case of about 55,000, and in a third case of about a hundred thousand. One is inclined to the latter figure.

But the particular appropriateness of mentioning those figures, which you have been through before, at this moment, would seem to be the difficulty of dealing with it may be compounded by overcentralization, by an effort to do a massive analysis. The particular reason that I want to reflect from our work is the problem of sampling.

There is the illusion, occasionally, that the scientific literature, scientific knowledge itself, can be samples in some fashion like the public taste for tea. But that is where we believe a crucial problem lies. While it is true that a scientific worker's scanning of information, such as one has to do in industry and technology, does involve a sampling, it is nevertheless a sampling with very special weighting factors applied to it.

These are compounded quite subtly from the experience and intuition and perception of the technical worker himself. It is a kind of process of ingestion. Instead of being able to get pills for food, which may be in prospect, we still find that the absorption of scientific information and technical information has to be done via the beefsteak, lobster, and spinach methods.

Senator HUMPHREY. It is lunchtime.

Mr. BAKER. I am trying to prepare you for the next part of the program.

We are gravely concerned that any method which would attempt to substitute for this kind of organic assimilation, a highly unweighted impersonal assimilation, of the literature would be dangerous.

We believe it would lead to an overlooking of many of the salient values of literature which are now obtained—referring again, for instance, to the classical case of Dr. Crane's Chemical Abstracts by the thousands of abstracters who do the survey job—and this is done all through the field of science, all the things that you have so expertly covered—the actual operation of literature processing depend ultimately on the judgments, the most indefinable human quality of evaluation by the individual worker.

We feel in industry, where we have such a grave need for expanding our knowledge and keeping up with all the discoveries of rapidly changing science and technology, that the mobilization of this great force of analysts who are themselves technical workers is something that should be encouraged in all ways, and should not be displaced or disturbed by hypothetically adequate substitutes.

We believe that in accord with much of the information you have already obtained that the effective way of encouraging this is by a correlation center or coordination center which would make clear what is being published in the world, what is being covered, what is being made available.

I would like to conclude by saying that we are very much struck by the fact that this area of scientific literature is where we are in business with the whole world. We are really dealing with the Iron Curtain countries by their scrutiny of our publications and our scrutiny of theirs, and their cross checking of our results and our observation and action on theirs. We can only urge that recognition of the fact that this is so fundamental to the advance of science everywhere, that the scientific information processing job is the job of every individual scientist and technical worker and engineer in our Nation.

Thank you, sir.

Senator HUMPHREY. Senator Thurmond?

Senator THURMOND. I have no questions.

Senator HUMPHREY. Senator Martin?

Senator MARTIN. Your idea is to urge us to proceed with our present plan that we have under study here, at least to the point of considering the setting up of a central coordinating agency of some kind without authority to direct the activities of those whom they contact? Is that correct?

Mr. BAKER. Yes, sir. That is our feeling.

Senator MARTIN. And not to attempt a complete massive accumulation of even an indexing center necessarily, but to encourage and help the science field throughout the whole country to go ahead as they are now doing, with some help from us that will not interfere with their own work?

Mr. BAKER. Yes, indeed.

Senator MARTIN. And you have had considerable experience in the practical application in that field. I thought perhaps you would give us a suggestion of where to draw that line, how far we should go and where we should stop our efforts to help in this field.

Mr. BAKER. I feel that you have expressed very accurately the needs that we feel there, and the drawing of a line requires more expert knowledge in the actual operation of literature handling than I myself have. But I would hope that it would be based on this central principle we were just talking of, and that is, that it be drawn where, if it were not drawn, there would be discouragement and reduction in the participation of individual technical workers and scientists in the literature processing itself. Some of that great corps of workers would stop abstracting or stop learning Russian or stop reading things.

Senator MARTIN. We most certainly don't want to discourage any of their full cooperation and in proceeding in their present work on an enlarged scale. We would not want to be a party to setting up a system here that would discourage or cut down their own present plans for expansion in the future.

Senator HUMPHREY. Senator Lausche?

Senator LAUSCHE. Mr. Baker, testimony has been given that there has been research in the efforts to develop mechanical devices that would aid in indexing and cataloging. You are the head of the Bell Telephone Research Laboratories. May I ask, have you or any of your associates participated at all in this type of research work?

Mr. BAKER. Indeed so, sir. Not in the contract program that has been mentioned, but in that subject of research. We would like, of course, to be able to do mechanical reading of things like telephone directories, of addresses, and such things. It was in this effort that

Dr. Claud Shannon, some 10 years ago, discovered a new field of science, really, called information theory, or communication theory as it is sometimes called, which lays a rigorous mathematical basis for beginning to make human language, human thoughts and ideas, accessible to language of machines, so that there can be conversation between man and machine in the most philosophic sense. We have been attempting to carry that on and learn ways to achieve experimentally with things, with devices, with machines, the possibilities that that principle revealed.

Senator LAUSCHE. That type of research has been going on, you say, for about 10 years?

Mr. BAKER. Yes, sir, just 10 years ago.

Senator LAUSCHE. Who is Mr. Shannon?

Mr. BAKER. He is the originator of this principle, a mathematician, a basic communications engineer, of considerable activity and vigor. He spends part of his time now at the Massachusetts Institute of Technology and part at our laboratories.

Senator HUMPHREY. Are you familiar with the research studies conducted by Western Reserve University?

Mr. BAKER. Yes, indeed.

Senator HUMPHREY. They showed us a film here of the machine that they have, in which they are able to draw together through a type of electronics device—I wouldn't say a catalog of information—selected items that relate to a particular subject or project. Are you doing research on that type of mechanical equipment?

Mr. BAKER. Yes. On the principles of it. We have great admiration for it and on the progress at Western Research. I think you will recall, in the film to which you refer, much of the programing equipment or input equipment looked like a telephone switchboard because it has plugs and jacks in it.

Senator HUMPHREY. It did.

Mr. BAKER. There is a very close correlation there.

Senator HUMPHREY. It seems to me there is a tremendous role for a laboratory such as yours, Bell Research Laboratories, in this whole field of mechanization insofar as mechanization can go. I think you have made the point that there is a line somewhere where mechanization stops and where the human factor still is a very vital part of the total program of documentation.

I would hope that, somewhere along the line, greater emphasis in the research field, so far as Government is concerned on contract research, would be placed on this mechanization project.

Because, with these tremendous numbers of documents, an unbelievable amount of literature piles up all over the world. Yet much of it of great value almost kills itself. It almost kills its own need unless it is usable, because the frustration of the mass of material is, within iteslf, a roadblock to the adequate use of time and talent on the part of the scientist who feels by his training that he must do the preliminary reading and research before he enters into the active research project.

Mr. BAKER. Indeed, so. With your permission, if I could cite a case that shows how this self-suffocation of scientific literature is going on; it is a rather interesting one in connection with your conversation because this now classic, this historic case of the application of a certain principle, Boolian in algebra, through the design of a relay

system, designed and published in 1950 from Russia, was overlooked for 5 years here, was actually first published by Shannon and one of his colleagues, Gilbert, about the end of 1948. So, it existed before the Russian publication, which is now cited as the primary publication, that was done before we did it the second time.

Senator HUMPHREY. What did you call that?

Mr. BAKER. Suffocation.

Senator HUMPHREY. That is a suffocation by a factor of two.

Senator Thurmond?

Senator THURMOND. Are the results of your research available in any institution?

Mr. BAKER. Yes, indeed. They are published and available.

Senator THURMOND. Can you tell us where?

Mr. BAKER. In the libraries. The Bell System Technical Journal, for instance, is one case where we publish in a great deal of detail. That is available to all college libraries. But the continuous flow of our research is available through the engineering and technical journals of the professional societies, such as Dr. Hutchisson's whole institute of physics complex of journals. We publish continuously there.

Senator THURMOND. There is so much magnificent research being done all over the country, I am just wondering if there is any one place a man can go, and there be able to find anything on a specific subject without traveling from California to New York, to Ohio, to South Carolina, or other places.

Mr. BAKER. Well, sir, the knowledge of almost everything, shall we say the indication of the existence of almost everything, that is done in the field of chemistry, is available in the Chemical Abstracts, which are themselves available in nearly every chemical laboratory, university, college, and many high schools throughout the country. So, it is highly decentralized.

Senator THURMOND. Is it your feeling that that system of compilation and dissemination of information would be preferable to a central library of science, where everything is registered and is available to anyone who seeks that information?

Mr. BAKER. Yes, sir; I do. I think that the Library of Congress has a unique and absolutely essential position as a place where, really, things are available, and lists and knowledge of what exists. But then I think there must be highly decentralized sources where people can stop in and read.

Senator THURMOND. I have been told that the Soviet Union has a central library of science and that one can go there, the scientist can go there, and study everything available, not only that has been researched in that country but in every country of the world; that they can obtain the information, the results of research and experiments, in that one library. Are you familiar with whether that is true or not?

Mr. BAKER. I have heard that, sir. I would think that, providing it is true, the significant thing may be that they have one. We have hundreds where most, or much, of the literature can be learned about. We believe this is vastly more effective. Perhaps I should point to it another way: Presuming they do have one, one is not enough.

Senator THURMOND. Exactly; specifically what role do you visualize the Federal Government should play in this field, if any?

Mr. BAKER. I believe it should be, sir, a role very like that which has been described already in terms of a helping hand, a correlation conscience, a kind of national conscience, and having the special property of a conscience, where you can read what is in it, in a sense that it should show the professional societies, the individual workers, the universities, and all—the research laboratories and all the rest—what the total field of literature to be covered is. Really just a list, for instance, of all the journals there are. There is no such list now. It should show all the ways that can be thought of, that are being thought of, and where they are being thought of, of how to deal with monster of literacy which is sort of engulfing us. And it should be, in general, as has been said, the authentic source of information on information.

Senator THURMOND. In other words, as I construe from your answer, what you mean is that the Federal Government would collate and make available to disseminators of information, the information that is available.

Mr. BAKER. Yes, sir. Exactly.

Senator HUMPHREY. I was interested in your phrase "monster of literacy." We have the problem here that we are burdened with the problem of literacy. And someplace else it is "illiteracy."

Senator LAUSCHE. For clarification of the questions asked by Senator Thurmond, one of the witnesses here testified that in Russia there has been an order of decentralization of their presently one source of supply of information. Who was that witness that testified to that? Will you identify yourself.

Mr. CLARK. I am Ralph Clark, Stanford Research Institute.

Senator LAUSCHE. Your information on the fact that they decentralized has come from where?

Mr. CLARK. It is public information. It has been published and comes from official Soviet decrees and so on.

Senator LAUSCHE. And having all in one central place was proved to be cumbersome and unworkable, is that correct?

Mr. CLARK. That is the inference to be drawn from the action.

Senator HUMPHREY. It is fair to say that there is a difference in having all documents, all information in one place, and having them under some kind of coordinating system with the proper techniques and helps that can designate other areas where the information is available, or to make the information available in abstract form.

Senator LAUSCHE. If I might say, I did not imply that Russia has an information center on information that can be had. Senator Thurmond said we should go there and find all the literature from all over the world. If it is so, it has proved unworkable.

Senator THURMOND. I am informed that they have a central point.

Senator HUMPHREY. Thank you very much.

We will recess until 2:30.

(Whereupon, at 12:48 p. m., the hearing was recessed, to reconvene at 2:30 p. m.)

AFTERNOON SESSION

Senator LAUSCHE (presiding). Mr. Conrad?

STATEMENT OF G. MILES CONRAD, CHAIRMAN, THE TEMPORARY COUNCIL AND EXECUTIVE COMMITTEE, NATIONAL FEDERATION OF SCIENCE ABSTRACTING AND INDEXING SERVICES; DIRECTOR, BIOLOGICAL ABSTRACTS, PHILADELPHIA, PA.

Mr. CONRAD. Dr. Crane, my distinguished colleague, showed you the index and a copy of Chemical Abstracts. This is a monthly issue of Biological Abstracts and the index to a year of such issues.

With your permission I would like to read my statement.

Senator LAUSCHE. Proceed.

Mr. CONRAD. My name is G. Miles Conrad. I am the director of Biological Abstracts and the chairman of the temporary council and interim executive committee of the newly incorporated National Federation of Science Abstracting and Indexing Services.

As an aside to my statement—because everyone has been identifying themselves with Ohio—although I was not born there, I did go to Oberlin College in Ohio.

Senator LAUSCHE. You have to be credited for going to Oberlin if not for coming from Ohio.

Mr. CONRAD. In developing my views regarding the role that the Federal Government might play in the matter of assembling, abstracting, storing, indexing, retrieving, and disseminating scientific information, I will describe briefly something of the background experience of Biological Abstracts that has led me to believe that through proper coordination of existing facilities we in the United States might attain rapidly a far better system of communication—if, indeed, we do not already have one—for all of science and technology than exists elsewhere.

Biological Abstracts is a nonprofit corporation established in 1926 by the joint action of the National Academy of Sciences, the American Association for the Advancement of Science, and the Union of American Biological Societies. The latter organization, since disbanded, has been replaced in fact by the American Institute of Biological Sciences.

The sole purpose of this corporation—Biological Abstracts—is "to provide a comprehensive abstracting and indexing organ for the world's research literature in theoretical and applied biology."

The affairs of Biological Abstracts are managed by a board of trustees of 12 members, 3 of whom must be representatives of the founding organizations while the others are selected to provide a cross section of biological interests from educational institutions, industry, and Government. The work of Biological Abstracts is carried on by a paid staff of 40 who coordinate the efforts of almost 1,000 volunteer workers.

A group of 150 eminent biologists serve without compensation as editors of the numerous specialized fields of biology served by Biological Abstracts (exhibit 1); another group of more than 600 biologists serve as volunteer abstracters; and, finally, the editors of hundreds of primary biological periodicals collect and forward to Biological Abstracts the abstracts prepared by the authors of papers published in their journals (exhibit 2).

As Dr. Crane has told you, Chemical Abstracts probably receives the equivalent of $500,000 worth of free service in this fashion. Because biologists are perhaps paid a little less than chemists, on the

average, we, I would imagine, obtain probably $350,000 worth of free services in this fashion.

In short, Biological Abstracts, the largest biological abstracting and indexing service in the non-Russian world, is a free-will cooperative enterprise undertaken by and for the biologists of the world and is, therefore, directly responsive to their needs. If such an enterprise were attempted on any other than a volunteer and cooperative basis not only would it soon lose touch with the research biologists who produce and use it, but the cost for personal services alone would foredoom it to bankruptcy.

However, even a nonprofit cooperative organization requires some cash with which to buy services and goods from those who do not otherwise benefit from the venture concerned. In Biological Abstracts' case the initial phases of its career were financed by grants of about three-quarters of a million dollars from the Rockefeller Foundation, but during the 32 years of its existence there has been a shift in its financing from dependence upon subsidy to dependence upon subscription earnings. Not only has there been this shift in the source of its revenue, but its circulation and earned income have enjoyed a modest but steady increase throughout the world (exhibit 3), despite war and economic depression.

I would like to add parenthetically to my mimeographed statement that yesterday, in the testimony, one of the speakers made the statement that "Biological Abstracts requires continual Government support in order to survive."

I should like to correct this impression. Actually, Biological Abstracts received grants and contracts during the period 1952 to 1957, and was grateful indeed to receive them. However, these funds were used to speed up our indexing, not to insure our survival.

From 1952 to date our income has totaled $1,857,000, and of this only 7 percent or $135,000 came from the Federal Government as a subsidy.

If the dimensions of the task for which Biological Abstracts was established had remained stable or had grown gradually throughout the intervening years there would be no problem today. However, during the same 32 years that Biological Abstracts was growing in this modest fashion, the scientific literature of biology was growing at a phenomenally rapid rate. Thus, 65 percent of the biological-research periodicals published throughout the world today have come into existence since Biological Abstracts was incorporated in 1926. Or, put differently, in the past 3 decades there has been an increase of 190 percent in the number of biological research journals published (exhibits 4 and 5).

Because the concern of this hearing is to obtain information relating to the abstracting and indexing of all of science and technology, it will be of interest to point out that the situation described for biology is paralleled by the situation in scientific publication generally, as has been many times before described in this hearing. The small table which follows shows the rates of growth since 1927 of scientific and technical journals published in the United States alone (data derived from U. S. Library of Congress Reference Department, Science Division, Scientific and Technical Serial Publications: United States, 1950–53. Washington: Government Printing Office, 1954).

Number and percent of journals published in the United States

	1927		1953	
	Number	Percent	Number	Percent
Biology (all, pure, and applied)	920	42.3	2,175	100
Pure, basic	175	38.8	450	100
Medicine	384	40.7	943	100
Agriculture	361	46.1	782	100
Physical sciences	130	33.7	385	100
Engineering and technology	474	41.2	1,150	100

You will see from the above table that in all of biology there was in the United States an increase of from 920 journals published in 1927 to 2,175 journals in 1953.

However, the package of information that concerns the abstracting and indexing services is not the periodical, but the periodical article. Studies show that the number of scientific articles in biology has grown in a direct 1-to-1 proportion with the growth of the periodicals. Thus, a careful estimate indicated that in 1930 about 55,000 biological research articles were published; in 1957 we estimate about 155,000 articles, or almost 3 times as many. This parallels quite directly the growth of the journals in biology.

Unfortunately, the income of Biological Abstracts, although growing, has not grown at so great a pace.

As the research literature of biology expanded, Biological Abstracts attempted to meet the challenge by the adoption of various devices that would enable it to stretch its modest fiscal resources. For example, it adopted early the practice of urging authors to prepare abstracts of their own scientific papers that would be suitable for publication in Biological Abstracts. This technique has now been adopted by many and, in modified form, has been adopted as a principle by the abstracting board of the International Council of Scientific Unions for abstracting in all fields of science and technology.

Biological Abstracts also early adopted the practice of exchanging reprinting privileges with other abstracting services in the specialized fields of biology and other allied sciences (exhibit 6). One of these agreements, that with psychological abstracts, is described in detail in exhibit 7. Through these devices and others, the editorial dollar has been extended despite inflation and rising costs of manufacture, and Biological Abstracts has become impressed with the mutual advantages that can be gained by cooperation and coordination.

When the Soviet All-Union Institute of Scientific Information was established in 1952, we watched developments with considerable interest. The interest turned to envy, however, when we saw their biological abstract journal (Referativnyi Zhurnal: Biologiia), which was starting in 1954, publish but not index, 107,610 abstracts in 1956—after only 2 years of existence.

In 1957 it published but did not index 104,040 abstracts.

In 1957, the same year, Biological Abstracts, with 30 years of experience behind it, could only afford to publish and index 40,000 abstracts. This year we will publish and index 42,500 abstracts; in 1959, 47,500 abstracts.

From our sketchy knowledge of the operations of the All-Union Institute it seemed apparent to us at Biological Abstracts that their ability to grow so rapidly came, in part, from the advantages of efficiency in handling and manufacture that a consolidated and centralized operation sometimes offers. For example, all incoming periodicals and abstracts could be sent to one building where they would be centrally classified and routed to the appropriate abstract service. Further, centralized composition and printing would probably effect substantial economies.

At the same time, however, it seemed to us that such a centralized system would be stultifying to the individual editorial policies of the 13 abstract journals published by the All-Union Institute.

Imagination and ingenuity play an important part in the creation and development of scientific information services so that they will best serve the varied and constantly shifting needs of science. It is, for example, reasonably well established that scientists working in different fields of science have rather different ways of communicating scientific intelligence to one another.

The editors of science abstracting and indexing services should be able to take these habits of their science into account when devising and developing their medium of communication. A centralized editorial control would most assuredly make it difficult for the editors of the individual journals to exercise extensively their creative imagination.

To us at Biological Abstracts—with our background of profitable cooperation with sister abstracting services and, yet, independence in the determination of editorial policy—it seemed that some kind of a free-will federation of American abstracting and indexing services in science and technology—and perhaps even the humanities as well—might provide many of the advantages of centralized operation with none of the disadvantages.

Acting upon this belief we talked informally with our abstracting and indexing colleagues in other fields of science and technology and learned that we were not alone in our frustrations.

The possibilities of cooperating with each other and coordinating our respective activities seemed very attractive to many of us. After several years of mere conversation, the advent of the sputniks provided the dramatic impetus required to take real and tangible action.

Through the good offices of the National Science Foundation funds were provided Biological Abstracts with which to organize and call together representatives from the major abstracting and indexing services of the United States for a conference in January of this year. The services represented at the conference, listed here, serve virtually all of the major sciences and technologies:

Aeronautical Reviews.
Applied Mechanics Reviews.
Bibliography of Agriculture.
Biological Abstracts.
Chemical Abstracts.
Current list of Medical Literature.
Engineering Index.
Mathematical Reviews.
Meteorological Abstracts.
Nuclear Science Abstracts.

Psychological Abstracts.
Review of Metal Literature.
Technical Abstract Bulletin (ASTIA).
United States Government Research Reports (OTS).

In addition, representatives of the following organizations, which are also concerned with the problems of science abstracting and indexing, participated in the conference:

American Association for the Advancement of Science.
Americal Geological Institute.
American Geophysical Union.
National Academy of Sciences.
National Science Foundation.
United States Joint Publications Research Service.
UNESCO.

The conference addressed itself to an examination of the ways in which the different abstracting and indexing services could coordinate and cooperate in their activities so as to enjoy some of the advantages of centralization without sacrificing the vital and essential freedom of editorial policy determination required to serve the best interests of their respective segments of the scientific community.

The principal result of the conference was the establishment, by unanimous action, of the National Federation of Science Abstracting and Indexing Services. The objective of the newly formed federation is to improve the documentation—abstracting, indexing, and analyzing—of the scientific and technological literature of the world in such a manner as to make it readily available to all scientists and technologists—

(*a*) By encouraging the development of abstracting and indexing for those specialized subject fields not at present covered by such services and the further development of existing services.

(*b*) By seeking greater uniformity in such matters as journal citations and abbreviations, and transliteration of foreign-language titles.

(*c*) By cooperation, education, research, and the pursuit of mutually useful enterprises, to strive for the best possible research information services for science and technology in the United States and abroad.

During the conference, the participants discussed, among others, the following problem areas in the documentation of science which will be given immediate and continued attention by the new Federation:

The establishment of standards in form, classification, abbreviations, and transliteration that could be adopted by member services;

Improved means of learning about new scientific publications;

Cooperative methods for insuring optimum coverage of scientific literature by the abstracting and indexing services of the United States;

Ways and means to provide user access to the primary publications abstracted and/or indexed by the various services;

Research and studies directed toward better indexing techniques that would help all the services to improve the quality of their indexes and the speed with which they are issued;

The development and adaptation of the new methods for printing indexes and bibliographic listings more economically and more promptly; and

The development and evaluation of new types of services for users.

Because so much has been said about the achievements of the Soviet All-Union Institute of Scientific Information and so little has been placed in the record concerning the achievements of the scientific information services of the United States you will, I think, be interested in the table below.

One of the important byproducts of the conference of American Scientific and Technical Abstracting and Indexing Services was the reporting by 14 of the participating organizations of their actual abstract coverage in their respective fields and an estimate of the total number of research articles in each field. These figures, which follow, present an accounting of the strength of the principal United States science information services in 1957.

I would like to make an addendum or correction to two points in this table. I have since talked with Dr. Crane and discovered that his estimate of the total number of chemical papers published in 1957 would be about 103,000, instead of the 110,000 indicated in my mimeographed statement. He feels that Chemical Abstracts' coverage, although very close to 100 percent, is actually about 98 percent.

The United States Government research reports did not provide us with an estimate of the potential reports that it might have published. I have estimated, therefore, 10,000.

With those modifications, it appears as though the pure abstract and index services have abstracted 236,000 items in a possible total of 440,000, or about 53 percent.

The "title listing services," in this case covering only agriculture and medical literature, have covered about 200,000 items out of a grand total possibility of 550,000, or about 57 percent.

Taking these two types of services together, the total coverage by United States services is 437,000 out of an estimated total of 790,000, or we have covered 55 percent of the scientific and technical literature, among these 14 services.

(The table referred to follows:)

Principal United States Science Information Services in 1957

	Actual articles covered	Total potential articles	Percent covered
Abstract services			
Aeronautical Reviews	6,770	13,000	52
Applied Mechanics Reviews	4,245	6,000	71
Biological Abstracts (inclusive of basic agriculture and medicine)	[1] 40,061	155,000	26
Chemical Abstracts	101,027	103,000	98
Engineering Index	26,300	50,000	53
Mathematical Reviews	9,200	10,000	92
Meteorological Abstracts	5,000	7,200	70
Nuclear Science Abstracts	14,042	14,500	97
Psychological Abstracts	9,074	12,000	76
Review of Metal Literature	8,219	10,000	82
Technical Abstracting Bulletin [2] (ASTIA)	[3] 4,276	50,000	9
U. S. Government Research Reports (OTS)	8,400	10,000	84
Subtotal	236,614	440,700	53
Title listing services			
Bibliography of Agriculture	96,258	150,000	64
Current List of Medical Literature	104,517	200,000	52
Subtotal	200,775	350,000	57
Grand totals of abstract plus title listing services	437,389	790,700	55

[1] 42,500 in 1958; thereafter Biological Abstracts will expand coverage at the rate of 5,000 abstracts per year.
[2] The Technical Abstracting Bulletin covers only Government-sponsored research reports.
[3] One-third year.

Mr. CONRAD. Although the United States "abstract" coverage by the services listed above is considerably below the 478,044 abstracts and titles published by the Soviet All-Union Institute in 1957, the table shows that when title listing services are added, United States and other English-speaking scientists and technologists have been provided ready bibliographic access to a minimum of 437,000 articles, or 55 percent of the estimated total of the world's scientific and technologic literature in the fields represented above.

I say "minimum", for there were in 1954—the most recent count I have available—no less than 228 additional abstracting and indexing activities in the United States serving specialized fields of science and technology.

If the product of these additional services were known I am reasonably sure we would find that virtually 75 percent of the total literature is currently covered, and that American scientists are far better off in this respect than are their Russian colleagues.

Obviously, with such a scattered system of abstracting and indexing, what is needed is not necessarily more abstracting, but better coordination of what already exists so that the potential user of information can find the bibliographic service suited to his requirements of the moment.

Another fact brought to the attention of the conference was that only 9 of the 13 services published by the All-Union Institute provide the user with subject indexes. Among those that do not contain subject indexes are the biological and chemical services which have a combined abstract coverage of 186,216. In contrast, the United States services listed in the table above provide subject indexes.

I should like to say, parenthetically, that if Biological Abstracts were freed of the cost of providing subject indexes it could immediately increase by 50 percent the number of abstracts it publishes.

Without subject indexes the value of any bibliographic service is reduced quite materially. In the final analysis, therefore, the truly effective coverage provided by the Soviet services is reduced to less than 300,000 articles per year as compared with the minimum United States total of 437,000.

Senator LAUSCHE. What is the source of this information?

Mr. CONRAD. From the member services that are listed in this table.

Senator LAUSCHE. And the source of the information on Russian activities?

Mr. CONRAD. The source of that is a paper that was prepared by Miss Rita G. Liepina, of the Office of Scientific Information of the National Science Foundation, entitled "Soviet Abstracting Services and Procedures."

The astonishing thing about the Russian effort, to my mind, however, is not the total number of articles covered, but the speed with which they have developed their science information program, imperfect in indexes though it be. Their achievement is all the more important since they had very little in the way of a scientific documentation system on which to build. In the United States, however, we are more fortunate, for we have already established a system of science abstracting and indexing that is second to none.

It is my considered opinion that the future role of the Federal Government in the assembling, documentation, and distribution of scientific information should take full advantage of the considerable resources in abstracting and indexing that already exist in the United States. As has been demonstrated, these well-established private and governmental services are already assembling, documenting, and disseminating at least 55 percent of the world's scientific and technical information. It is an insufficiency of funds that keeps us from greater coverage, not indifference to the growing literature.

I would recommend, therefore, that the Federal Government continue to support by direct and adequate appropriation the many outstanding abstracting and indexing services which are already being published by the various departments and agencies.

In addition, however, I would recommend that some division of the Federal Government be designated to oversee the welfare of the established private abstracting and indexing services and come to their aid when subsidy or other assistance is required.

This same Government division should also be charged with the determination of the need for new services and should assist in the establishment of such services under appropriate nonprofit sponsorship. To a limited degree and in a piecemeal fashion this governmental function is being provided by the Office of Scientific Information of the National Science Foundation. There seems to me no practical reason why this same Office could not be strengthened with the funds and personnel necessary to perform a truly adequate job in the future.

Senator LAUSCHE. Am I correct in my recollection that the testimony given by Rossini and his associates this morning recommended that the National Science Foundation be vested with the responsibility of administering those funds which might newly be established as Federal participation?

Dr. Rossini?

Dr. ROSSINI. We didn't quite say it that way, Mr. Chairman. I think we wanted to leave that open to await the findings of this advisory board that would study the whole problem.

Senator LAUSCHE. Pardon me. Proceed.

Mr. CONRAD. I am personally convinced that the National Federation of Science Abstracting and Indexing Services, if properly supported by Federal subsidy when necessary, could assist materially in the achievement of all of the objectives of S. 3126—that pertain to this problem—and yet avoid the centralized editorial control that would necessarily accompany any huge documentation center created by the United States Government in the image of the Soviet All-Union Institute.

Indeed, I would visualize the Federation as an advisory link between the Government and the independent abstracting and indexing services in determining the need of subsidies for existing services and the creation of new ones.

Finally, I am aware of the prestige that any organization enjoys that bears the endorsement of the people of the United States as expressed through their Congress. For this reason, although this may not be the appropriate occasion, I would respectfully petition the Congress to grant a Federal charter to the National Federation of Science Abstracting and Indexing Services, thus signifying the highest endorsement of the basic importance of its efforts to the future of science and technology in the United States and throughout the world.

Thank you, gentlemen, for this opprotunity to present my views on the role of the Federal Government in the documentation of science and technology. I hope that some of the information I have been able to provide will assist the committee in its consideration of S. 3126.

Senator LAUSCHE. Thank you very much for this illuminating presentation.

Senator Martin?

Senator MARTIN. Your statement is a very good statement for our purposes. You have such a background of experience, your recommendations are very strong and are calculated not to impose the Government unduly in the field, except where it can be helped. I agree with that approach strongly, and I think the other members of the committee agree with that, until we know what can be done.

I wonder if you have any statement as to the beginning cost, the Government's cost of the plan as you have recommended? Would it be limitless or moderate?

Mr. CONRAD. I don't think it is limitless. I think it can and probably should start out in moderate fashion. The actual amount I would hesitate to say at this point. I believe it would be very necessary to do this gradually over a period of 3 to 4 years' time to equal the Soviet achievement in terms of quantity of abstracts published, and indexed.

Senator MARTIN. You have stressed certain functions here that seemed to be within our reach without going off the deep end, so to speak, in getting started. You haven't included the impossible, such as a vast central massing of material with a worldwide operation. You seem to hold it fairly within bounds in your recommendation.

Mr. CONRAD. I would say so, sir. I rather like the analogy which was brought up yesterday regarding the network of the telephone-

communication system, whereby these several services supplement and complement each other. I think right now they do this. By strengthening each one individually we will achieve the desired end of virtually complete information facilities.

Senator MARTIN. I like the ideas that have been suggested here, which seem to have been in agreement by the witnesses in the field of science, and not contested. We have to look to all of you who have come here as representatives of the field of science for guidance and advice and counsel. I know no proper bounds here myself. I don't know how far we can plan in this legislation until we get a better picture, such as you bring to us.

I don't recall hearing just exactly what fields to which you limited your recommendation. I noticed you mentioned abstracting and indexing.

Mr. CONRAD. I stayed pretty closely to that, of course. This has wider implications. Much of what has been discussed here with reference to mechanizing of services, and so on, pertain to the federation of abstracting services as well. We would be interested in this research.

Senator MARTIN. Your report of achievement to date within the United States is rather encouraging.

Mr. CONRAD. I think we were quite encouraged ourselves when we managed to tally it up.

Senator MARTIN. A little more encouragement from the Federal Government would help.

Mr. CONRAD. I think it would, sir.

Senator MARTIN. I want to thank you for a very good discussion and a real addition to the testimony given to date.

Mr. CONRAD. Thank you.

Senator LAUSCHE. The bill which we are considering proposes the establishment of the United States Department of Science and Technology. Title II of this bill declares the policy that shall guide what will be known as the National Institutes of Scientific Research.

Section 202 provides, Mr. Conrad:

> The Secretary is hereby authorized to establish or to support the establishment of one or more research centers or institutes in each of the following fields: mathematics, engineering, physical science, to include but not limited to physics, chemistry, astronomy, geophysics, oceanography, and meteorology, the biological sciences, and the social sciences. Such research centers or institutes shall be devoted primarily to the conduct of basic scientific research, and may be operated by the Department directly or through support to private, nongovernmental institutions or agencies.

Have you given this phase of the bill any study?

Mr. CONRAD. I read it but did not study it or consider it.

Senator LAUSCHE. Do you want to express an opinion concerning the wisdom and the need of the Government getting into the actual establishing of centers of institutes for such research?

Mr. CONRAD. I would prefer not to comment on this at this time.

Senator LAUSCHE. Section 203 provides "for the establishment of institutes for research in applied science."

I suppose you are not in a position to express an opinion on that.

Mr. CONRAD. No, sir.

Senator LAUSCHE. Have any of the associations with which you have been attached had discussions suggesting that the Federal

Government ought to establish its institutions to conduct this research work?

Mr. CONRAD. Not while I have been connected with them.

Senator LAUSCHE. Except that which has been called to your attention in this bill, have you participated in or have you heard any discussion suggesting the need of such institute?

Mr. CONRAD. Not in reference to this specific bill. But of course I have heard suggestions, much as I have made, that some research organizations might be provided in the Government somewhere for basic research in documentation.

Senator LAUSCHE. And the development of mechanisms for indexing and so forth?

Mr. CONRAD. I have heard this suggestion, yes.

Senator LAUSCHE. Is there anything further that you desire to say?

Mr. CONRAD. Nothing further.

Senator LAISCHE. Thank you very much.

Mr. CONRAD. Thank you.

Senator LAUSCHE. The exhibits which were attached to your testimony will be made a part of the record, except that exhibits Nos. 1 and 2 will be made a part of the record by reference.

(The material referred to (exhibits Nos. 1 and 2) can be found in the files of the subcommittee.)

(The exhibits referred to are as follows:)

EXHIBIT NO. 3

BIOLOGICAL ABSTRACTS—FROM ALABAMA TO ZANZIBAR

As a companion piece and supplement to the article that appears on the opposite page, you may be interested in the whereabouts of those who subscribe to and use Biological Abstracts. Although referred to as "circulation" and often, therefore, thought of in commercial terms, this dissemination of the knowledge garnered in our abstracts is the true test of the success with which Biological Abstracts is providing the world of biology with research intelligence. We are proud of our record in this regard.

Of the approximately 92 independent countries of today's world, Biological Abstracts is sent regularly to 64. Fifty-four percent of all subscriptions is circulated within every one of the United States and its Territories; 25 percent goes to Europe and the Middle East; 9 percent to Asia; 5 percent to Canada and Mexico; 3 percent to South and Central America; 2 percent to Africa; and 2 percent to Australasia. The 10 countries other than the United States that receive the largest number of copies are—

	Percent		*Percent*
Japan	5.0	Germany	2.5
Canada	4.2	France	2.0
Great Britain	4.0	Russia	1.9
India	3.0	Netherlands	1.5
Italy	2.8	Czechoslovakia	1.4

Of the total circulation of Biological Abstracts, its special sectional editions constitute 59 percent and the complete edition, 41 percent. The sections, which were designed primarily to fit the pocketbooks and specific interests of individuals, are distributed in the following proportion:

	Percent
General biology (sec. A)	18
Basic medical sciences (sec. B)	20
Microbiology, etc. (sec. C)	23
Plant sciences (sec. D)	26
Animal sciences (sec. E)	13

Finally, an analysis of the kinds of organizations throughout the world that subscribe to and use the complete edition shows the following groups and their proportionate ranks:

	Percent
Universities and colleges	47
National and local government agencies	24
Industrial and commercial organizations	16
Nonprofit laboratories, museums, etc	11
Individuals	2

EXHIBIT NO. 4

THE EXPLOSIVE GROWTH OF BIOLOGICAL RESEARCH LITERATURE

If you've noticed an increasing difficulty in keeping up with the research writings in your special field, you're not alone. It's just as hard, relatively, for the abstracting and indexing periodicals that serve you. In planning the future growth of Biological Abstracts' coverage we have taken a long and detailed look at the growth of biological literature in the past and have attempted to project its growth into the near future. By tabulating chronologically by dates of their origin those biological journals which contain original reports of research—see the accompanying graph—we have learned several things which may have far-reaching implications for the science of biology. First, for example, since the beginning of the 19th century the number of biological-research journals published has doubled on an average of every 18 years. Second is the fact that only 35 percent of the journals in existence today were being published in 1927, the year in which Biological Abstracts commenced publication. Or, put another way, 65 percent of the biological-research journals published today have come into being during the past 30 years.

The best estimates put the present number of biological-research journals published throughout the world at 3,500. If the creation of new journals continues at the same rate it has in the past, we can expect 7,000 journals by 1975; 14,000 by 1993; and about 21,000 by the year 2000. This growth of journal publication when translated into terms of individual articles suggests an annual volume of 490,000 research articles in 1975; 910,000 in 1993; and about 1,470,000 in A. D. 2000 If some new method isn't soon devised for the primary communication of research findings in biology, and if Biological Abstracts were able to provide complete coverage of this projected literature, its volume 74 (A. D. 2000) would require 120,000 pages of abstracts, 21,000 pages of subject index, and measure some 30 feet in thickness.

To report, analyze, and index such an annual volume of information is impossible of accomplishment by means of present-day methods and financial resources. Although it is undesirable to shut off the volume of research writing at its source by formal censorship, we are tempted to suggest that unless the present and potential future flow of writings is stemmed or diverted by the exercise of personal censorship and restraint in publication, biological literature may soon overwhelm us all in a chaotic flood.

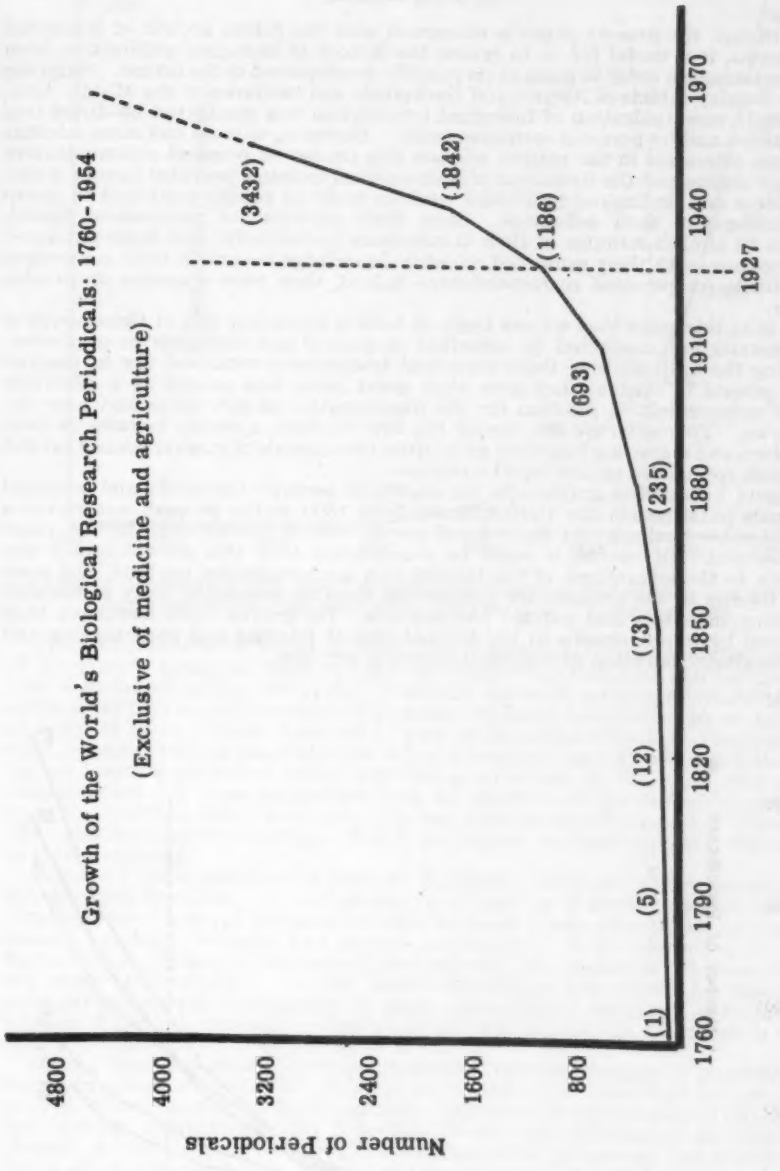
Growth of the World's Biological Research Periodicals: 1760-1954
(Exclusive of medicine and agriculture)
Number of Periodicals
4800
4000
3200
2400
1600
800
1760
1790
1820
1850
1880
1910
1940
1970
1927
(1)
(5)
(12)
(73)
(235)
(693)
(1186)
(1842)
(3432)

EXHIBIT No. 5

[From Biological Abstracts, Philadelphia, Pa.]

GROWTH OF BIOLOGICAL LITERATURE AND THE FUTURE OF BIOLOGICAL ABSTRACTS

(G. Miles Conrad)

Although the present paper is concerned with the future growth of Biological Abstracts, it is useful for us to review the history of biological publication from its beginnings in order to guess at its possible development in the future. Skipping over the clay tablets of Assyria and the herbals and bestiaries of the Middle Ages, the early communication of biological information was conducted by direct oral discussion and by personal correspondence. However, as more and more scholars became interested in the natural sciences this process of personal communication did not suffice and the formation of philosophical scoieties provided forums where the ideas and findings of individual workers could be readily conveyed to group assemblages of their colleagues. Soon these societies for purposes of record, began to publish minutes of their transactions periodically, and these published proceedings with their contained scientific knowledge became a most convenient substitute for personal correspondence—indeed, they were a species of circular letter.

It is at this point that we can begin to have a numerical idea of the amount of communication conducted by scientists in general and biologists in particular. During the 18th century these periodical transactions remained few in number and general in content, but soon their great value was proven as a relatively rapid communication medium for the dissemination of new ideas and new discoveries. Thereafter we see, during the 19th century, a steady increase in their numbers and a growing tendency away from the journals of general science toward journals specialized as to subject coverage.

Figure 1 illustrates graphically the growth of periodical scientific and technical journals published in the United States from 1800 to the present, and shows a considerable similarity in the several growth curves throughout the 150 years represented. Of course, it must be remembered that this growth is not due merely to the advantages of the journal as a communication medium, but must also be due to the pressure for publication from an increasing body of research workers, inventors and natural philosophers. Its growth must also have been fostered by improvements in the technologies of printing and papermaking and the resultant reduction in the relative cost of printing.

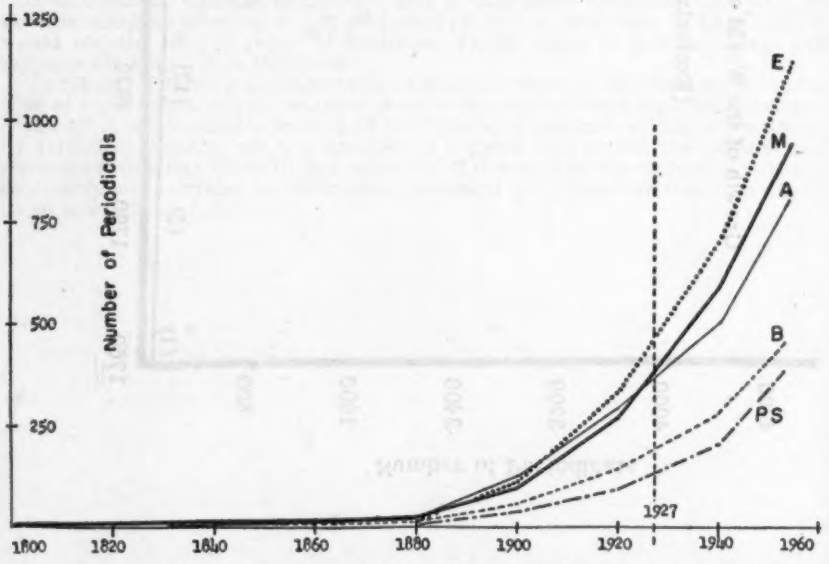

FIGURE 1. Growth of scientific and technical periodicals in the United States from 1800 to 1954. Data from (5). *Key: E*, engineering and technology; *M*, medicine; *A*, agriculture; *B*, biology; *PS*, physical sciences.

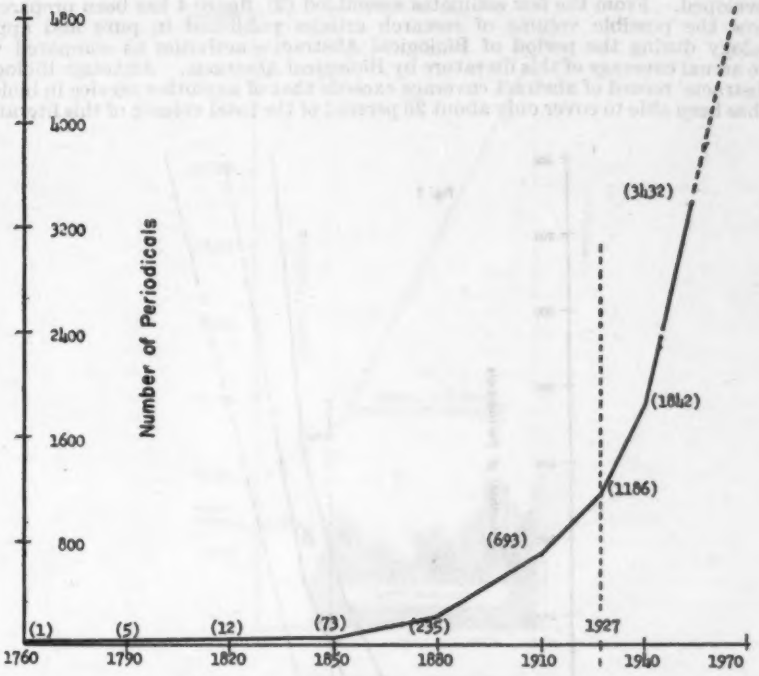

FIGURE 2. Growth of the world's biological research periodicals (exclusive of agriculture and medicine) from 1760 to 1954. Data from (6).

The next chart (fig. 2) brings us closer to our interest, for it represents the growth of the world's biological research journals, exclusive of medicine and agriculture, over a period of nearly 200 years. Probably the most notable attribute of this curve is the fact that the number of journals published has doubled on an average of every 18 years. From the point of view of Biological Abstracts, however, the most significant thing about this curve is the fact that only 35 percent of the biological journals published today were being published in 1927, the year of its establishment. I must emphasize that 65 percent of the biological research journals published today have come into being during the 30 years that Biological Abstracts has been functioning. This is the crux of our problem and I will return to it in a moment.

Because I have promised to refer to Biological Abstracts' future coverage of physiological literature, the next chart (fig. 3) may be of special interest, for it is a breakdown of some of the data recorded on figure 2 into several specific areas of biology—zoology, botany, and animal physiology. It is interesting to note that although the actual numbers of journals vary, the profiles of the three curves are remarkably similar. As you know, physiology has shown an especially phenomenal growth during the 30 years since 1927. Although the absolute number of journals currently published in this field is only 219, this figure is more than five times the number published in 1927.

During this same period Biological Abstracts' relative coverage of physiological literature has grown from 1927, when it accounted for 19 percent of the contents, to 1956, when it accounted for 26 percent. Inasmuch as the increase of physiological journals constitutes about 8 percent of the total increase of all biological journals during the past 30 years, it is apparent that physiology has received its fair share of a proportionate increase in coverage, and this will continue to be the case.

Recorded information that is reasonably easy of access has enabled us to learn something of the growth of journal publication. However, the unit of information which must perforce concern the abstracting and indexing service is not the journal but the individual journal article. Here the information is less well

developed. From the few estimates assembled (2), figure 4 has been prepared to show the possible volume of research articles published in pure and applied biology during the period of Biological Abstract's activities as compared with the actual coverage of this literature by Biological Abstracts. Although Biological Abstracts' record of abstract coverage exceeds that of any other service in biology, it has been able to cover only about 26 percent of the total volume of this literature.

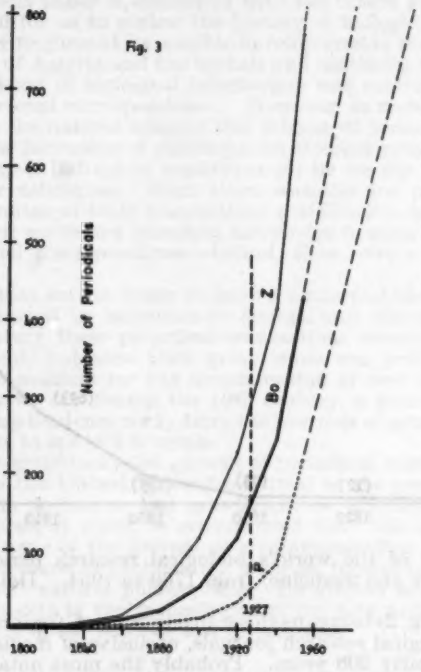

FIGURE 3. Growth of the world's specialized biological research periodicals from 1800 to 1954. Data from (6). *Key:* *z*, zoology (exclusive of physiology); *Bo*, botany; *P*, physiology (animal).

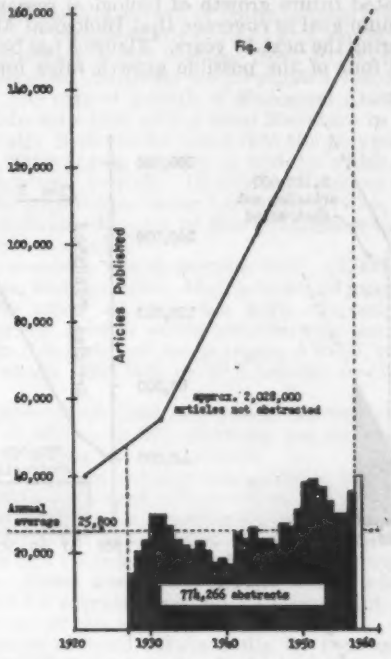

FIGURE 4. Estimated growth of biological research literature from 1921 to 1956, and its coverage by Biological Abstracts from 1927 through 1956.

Schramm (3) estimated that approximately 55,000 articles of biological research interest were published in 1930. Zwemer (7) has estimated that in 1954 there were about 144,000 such articles. Although these estimates were arrived at independently of each other and without direct reference to the journal growth figures discussed above, it is most interesting to note that Schramm's estimate of articles published for 1930 is 38 percent of Zwemer's estimate for 1954. The journal survey shows that the total number of biological journals published in 1930 is 38 percent of those published in 1954. So close a similarity in percentages between article and journal growth is probably coincidence, but in the absence of conflicting data it can be assumed that the abstracting task of Biological Abstracts has almost tripled in the 30 years of its existence.

Unfortunately, during most of these same 30 years Biological Abstracts was fighting for its financial existence. As a result, although averaging 26,000 abstracts per year, Biological Abstracts' relative coverage of the estimated total output of research writings dropped alarmingly from about 45 percent in 1930 to about 17 percent in 1954. In 1957, with the publication of 40,000 abstracts, Biological Abstracts will cover approximately 25 percent of the current research literature.

What of the future? Figure 5 projects the growth of biological research article publication into the first decade of the 21st century. If the growth of biological literature continues at the same rate it has assumed in the past 30 years we can expect that in the year 2010 alone about 348,000 articles will be published. Perhaps before that time some new and more efficient method of communicating information will have come into being—possibly ESP? In the meantime, though, for the next 30 or 40 years we are probably tied to the book format for the widespread communication of biological intelligence. What can Biological Abstracts do to keep abreast of this staggering task of abstract coverage?

In order to plan the orderly growth and development of Biological Abstracts as it begins its fourth decade of service, the staff and trustees have recently completed a careful study of past experience with reference to income sources, personnel requirements, production costs, etc. The data derived from this study have been

applied to the estimated future growth of biological research literature in order to ascertain the optimum goal in coverage that Biological Abstracts could reasonably hope to reach during the next 10 years. Figure 5 has been extracted from this study and illustrates four of the possible growth rates for Biological Abstracts that were considered.

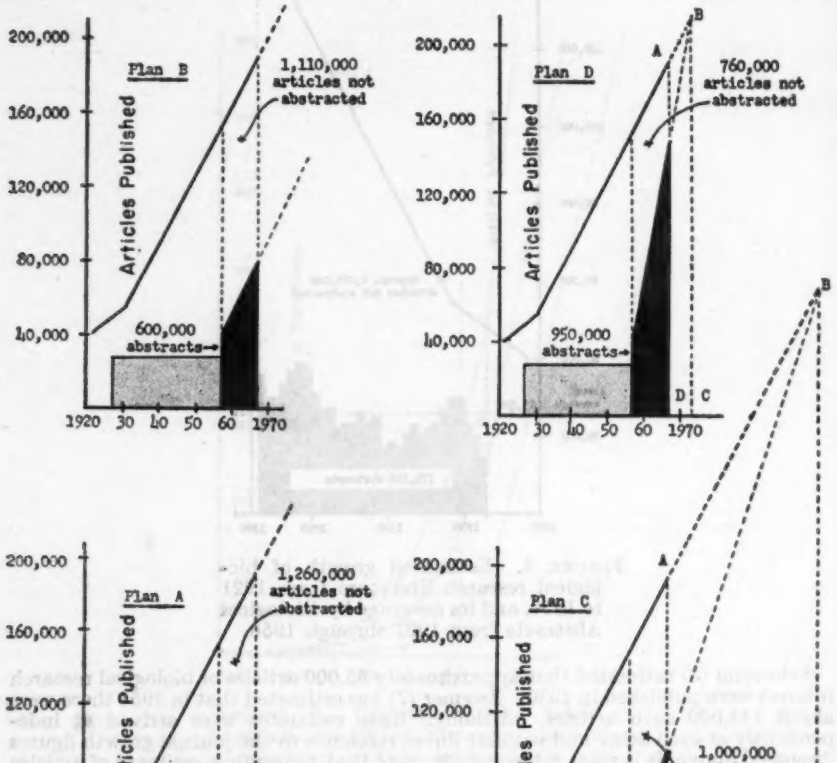

FIGURE 5. The possible growth of biological literature from 1957 through 1966 [illegible] and its coverage by Biological Abstracts under Plans A, B, C, and D.

Plan A.—Abstract coverage would increase at approximately Biological Abstracts' present rate, rising from 40,000 in 1957 to 50,000 per annum by 1966. During this 10-year period, Biological Abstracts would publish 450,000 abstracts or 26.3 percent of the 1,710,000 biological research articles that probably will be published during the next decade. The rate of Biological Abstracts' growth would be so slow that it would never catch up with the literature's growth.

Plan B.—Abstract coverage would increase from 40,000 to 80,000 during the next decade, and Biological Abstracts would publish 600,000 abstracts, or 35.1

percent of the total. The rates of growth of both the total literature and Biological Abstract's coverage would be essentially parallel and would never coincide.

Plan C.—Abstract coverage would increase from 40,000 to 100,000 during the next 10 years, and Biological Abstracts would publish 710,000 abstracts, or 41.5 percent of the total. The rate of growth of Biological Abstracts' coverage under this plan would coincide with that of the total literature in the year 2009 A. D. (As an interesting statistic, it should be noted that the polygon, ABCD, represents approximately 11,653,000 research articles in biology which might be published during the 43 years from 1967 to 2009. Of this huge volume of literature, Biological Abstracts would be required to cover 9,675,000 articles, or 83 percent of the total. At $6.50 per abstract the cost of this program would be $62,887,500 or an average of $1,462,500 per year.)

Plan D.—Abstract coverage would increase from 40,000 to 150,000 per year during the next 10 years, and Biological Abstracts would publish 950,000 abstracts or 55.5 percent of the total. If this plan were adopted, however, Biological Abstracts' rate of coverage growth would concide with the total literature's rate of growth in 1973. (In this instance, the polygon, ABCD, would represent about 1,400,000 articles, of which 1,267,000, or 90.5 percent would be covered by Biological Abstracts.)

After careful consideration of these four plans, the trustees have adopted plan B—an increase from 40,000 to 80,000 abstracts per annum—as a working goal for Biological Abstracts during the next decade.

With the volume of biological writings increasing at an exponential rate, on the one hand, and the costs for personnel, commodities, and services increasing sharply on the other, Biological Abstracts must either increase its subscription income substantially or cut its production costs materially. We are striving to do both.

Subscription income can be increased by a rise in subscription rates and/or an increase in circulation. Rates were raised in 1956 and it is hoped that the present level can be maintained for several years more. Campaigning for new subscribers is a never-ending activity of the central office staff.

Production costs can be reduced substantially by increasing the relative productivity of the central office personnel. Biological Abstracts envisions such an increase in productivity through an increasing application of automation. Thus, by the adoption this year of IBM techniques in the production of the monthly and annual author indexes a saving of 254 typist-days is anticipated. This saving is being applied to increased abstract and subject index production. Similar applications of automation will be made to other activities as soon as feasible and practical programs have been developed. The use of author's abstracts, too, although spurned by some abstract services, has been an important factor in helping Biological Abstracts to keep costs down during the past. Increased use of author's abstracts can be counted upon to further reduce costs in the future.

Although perhaps not completely pertinent to the topic of my paper it should be noted, in conclusion, that the very success of the periodically published journal may contain within it the elements of its own destruction. As one surveys the almost incredible number of journals extant today and realizes the difficulties which this staggering volume of literature presents to the individual research worker—and, by extension, to the abstracting and indexing service that must analyze and make it available—it seems as though we will soon reach and exceed the optimum utility of this medium of communication. In 1952 there were 50,000 scientific and technical journals in existence throughout the world (1, 4); in 1970 there will probably be 100,000 and by 2006 A. D., if the doubling continues, there may be 400,000.

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Exhibit No. 6

General Principles of Cooperation on Biological Abstracting

Recent studies of the literature of biology and its coverage by abstracting services make it very evident that there is an urgent need for a wider and more efficient coverage of the world's biological literature. In an effort to provide biologists with a truly comprehensive abstract coverage of biology, the trustees of Biological Abstracts have adopted the following general principles of cooperation on biological abstracting as the bases on which they are prepared to cooperate with any and all abstracting and indexing services.

1. INTRODUCTION

1.1 There is great need for more efficient abstract coverage of world biological literature.
1.2 Certain areas of the literature of biology are well covered but others are relatively untouched.
1.3 Conservation of the time and efforts of biologists makes it imperative to devise ways to avoid duplication in abstracting services.
1.4 An abstract is considered to be a greatly condensed version of an original research paper.

2. PARTIES TO ANY AGREEMENT

2.1 Biological Abstracts, Inc. would welcome the opportunity to negotiate specific bilateral agreements with any abstracting service under the broad terms of this instrument.
2.2 These principles are so phrased that any abstracting service or association of scientists may cooperate.
2.3 Indexing services are also invited to cooperate.

3. CLEAR INDICATION OF AREAS OF CORE COVERAGE BY A COOPERATING SERVICE

3.1 A hard core of journals which a cooperating service proposes to abstract as completely as possible should be made known in advance.
3.2 Duplication of the abstracting of core journals should be avoided by each service, when possible.
3.3 Service in a given country should give first consideration to adequate coverage of the major journals of its own country.
3.31 Ease of access, speed of getting journal to abstracter, page proof, and language are factors determining journal coverage.
3.4 Services with limited subject interests could also participate by indicating the journals they would cover completely.

4. SELECTIVE ABSTRACTING

4.1 To provide broad coverage a cooperating service may, in addition to its core coverage, publish abstracts selected with reference to subject matter, as well as geographic and linguistic representation.
4.2 Selective abstracting may be done by staff and/or voluntary abstracters.
4.3 Selective abstracting may also be accomplished by use of abstracts prepared by other services and reprinted under bilateral agreements.

5. PERMISSION TO USE ABSTRACTS OF OTHER SERVICES

5.1 By mutual agreement one service may use the abstracts prepared and published by another service,
5.11 provided credit for the source is given with each abstract.
5.2 Percentage or number of abstracts so used would be specified in the agreement in order to insure that each service would be a substantial producer of new abstracts.

5.3 Initially the percentage of abstracts used under reprint privileges should be a relatively small portion of the abstracts prepared by a cooperating service,
5.31 in order to protect the small specialized service from unfair competition.
5.4 Selective reprinting would permit a cooperating service to include or exclude abstracts according to its own standards.

6. PROMOTION OF WIDER INTERNATIONAL COOPERATION

6.1 Greater international cooperation should be sought through appropriate international organizations.
6.2 Wide publicity should be given to the availability of cooperation under the above terms.
6.3 The ICSU (International Council of Scientific Unions) Abstracting Board, which is promoting successful international cooperation in physics abstracting and is beginning to expand its services to chemistry, should be encouraged by UNESCO (United Nations Educational, Scientific, and Cultural Organization) to include biology in its scope.
64. Cooperation in the abstracting of biology in medicine should be stimulated through CIOMS (Council for International Organizations of Medical Sciences) and WHO (World Health Organization).
6.5 Similarly, in agriculture the services of FAO (Food and Agriculture Organization) should be solicited.
6.6 As opportunities develop, negotiations looking toward further integration of comparable services will be explored.

EXHIBIT NO. 7

BA AND PSYCHOLOGICAL ABSTRACTS

COMMENCE A PROGRAM OF COOPERATIVE ABSTRACTING

On January 1 Biological Abstracts and our distinguished sister abstracting service, Psychological Abstracts, published by the American Psychological Association, initiated a new and revolutionary agreement for the exchange of abstract reprinting privileges. This new agreement, we both hope, will serve as a pattern for an attack on the problem of the costly and inefficient duplication of abstracting efforts that plagues the documentation of science today. Although our two services have exchanged abstracts since 1929, heretofore there has been no systematic attempt to apportion responsibility for coverage so that duplicate abstracting effort could be avoided.

Now, however, in keeping with the General Principles of Cooperation on Biological Abstracting (Science, vol. 123 (3197), April 6, 1956; Biological Abtracts, vol. 30 (6), June, 1956) we have agreed to share responsibility through a guaranteed coverage of certain core journals that are essential to our respective fields of interest. Thus, for example, those journals primarily concerned with physiology or neurology that contain occasional articles of psychological interest will be the abstracting responsibility of Biological Abstracts. Psychological Abstracts will refrain from abstracting these journals, but will reprint in its pages those BA abstracts pertinent to its audience. Similarly, Psychological Abstracts will assume full responsibility for the complete abstract coverage of those phychological journals that contain occasional articles of physiological and neurological interest and Biological Abstracts will reprint those PA abstracts of value to its readers.

Initially this shared responsibility will involve a total of about 50 journals. It is expected that the elimination of the former duplication in abstracting will enable each service to redirect the efforts thus saved into areas incompletely covered at present. In addition to covering a group of specific core journals, each service will be free to reprint an additional number of abstracts randomly selected from the pages of the other service to a total of 500 abstracts for BA and 1,000 for PA.

The primary journals whose total abstract coverage will be the responsibility of Psychological Abstracts are:

Acta Psychologica
American Journal of Psychology
American Psychologist
British Journal of Educational Psychology
British Journal of Medical Psychology
British Journal of Psychology
British Journal of Statistical Psychology
Journal of Abnormal and Social Psychology
Journal of Applied Psychology
Journal of Clinical Psychology
Journal of Comparative and Physiological Psychology
Journal of Consulting Psychology
Journal of Experimental Psychology
Journal of General Psychology
Journal of Genetic Psychology
Journal of Psychology
Journal of Social Psychology
Psychiatric Quarterly
Psychological Bulletin
Psychological Monographs
Psychological Review
Psychometrika
Psychosomatic Medicine
Quarterly Journal of Experimental Psychology

In the future, therefore, abstracts of interest to biology from the above journals will be presented to the users of Biological Abstracts as reprints of the abstracts that appeared originally in Psychological Abstracts.

Senator LAUSCHE. Mr. Melville J. Ruggles is our next witness.

Mr. Ruggles, will you proceed?

The document which you have just given Senator Martin and myself are notes, and not a transcript of what you contemplate testifying to?

STATEMENT OF MELVILLE J. RUGGLES, ASSOCIATION OF RESEARCH LIBRARIES

Mr. RUGGLES. Yes, Mr. Chairman, and I would prefer that they not be inserted in the record because they are rather rough notes from which I will speak.

Senator LAUSCHE. There has just been handed to me a letter written by Stephen A. McCarthy, addressed to Mr. Walter L. Reynolds, staff director, Senate Committee on Government Operations, the substance of which is that Mr. Ruggles does represent the Association of Research Libraries. This letter will be transcribed into the record.

(The letter referred to is as follows:)

ITHACA, N. Y., *May 2, 1958.*

MR. WALTER L. REYNOLDS,
Staff Director, Senate Committee on Government Operations,
Senate Office Building, Washington, D. C.

DEAR MR. REYNOLDS: In the absence from the country of William S. Dix, executive secretary, Association of Research Libraries, Senator Humphrey's letter regarding hearings on S. 3126 has been referred to me as a member of the advisory committee of the association.

We appreciate Senator Humphrey's courtesy in extending an invitation to the Association of Research Libraries to present a statement for inclusion in the record of the hearing or to have a witness testify on behalf of the association. We have arranged for Mr. Melville Ruggles to testify for the association on the question of translation of foreign scientific publications. It is my understanding that Mr. Ruggles has been in touch directly with your office and has tentatively arranged to testify on Wednesday, May 7. Mr. Ruggles will confirm this date with your office on Monday.

In addition to Mr. Ruggles' testimony I wish to present the following statement on behalf of the Association of Research Libraries: (Text has also been sent to Senator Humphrey by wire.)

The Association of Research Libraries, whose membership consists of the 50 largest research libraries of the Nation, wishes to record its interest in and support of proposals designed to improve the dissemination of foreign scientific and tech-

nical information. In such measures as may be undertaken to this end the association urges that full use and advantage be taken of existing Government and private agencies and programs for collecting, translating, abstracting, indexing, and distributing scientific and technical information. Effective coordination of existing programs and the provision of increased support for public and private agencies now engaged in this field should provide the thorough coverage required more promptly and more efficiently than could be done through a new office or bureau.

Sincerely yours,

STEPHEN A. MCCARTHY,
Director, Cornell University Library; Member, Advisory Committee, Association of Research Libraries.

Mr. RUGGLES. Mr. Chairman and Senator Martin, in the first place, Senator Lausche, I don't know at this point whether it is a matter of pride or apology to say that I was not only educated at Oberlin but was born and raised in Toledo.

Senator LAUSCHE. Thank you very much.

Mr. RUGGLES. Gentlemen, my name is Melville J. Ruggles. I am vice president of the Council on Library Resources, Inc. of Washington, D. C. But as has been indicated by the inserted letter in the record, I represent here today the Association of Research Libraries, an association which includes approximately 50 of the outstanding research libraries in the United States.

The Association of Research Libraries has asked me to appear before this committee, and you have been gracious in inviting me, probably because I have been conducting, in collaboration with a very able colleague, Vaclav Mostecky, a study for that association on the resources of American research libraries in Soviet publications and the publications of Eastern Europe. In that connection, we have looked into various things, including the problem of translation. ARL asked me to appear here today in connection with that subject; the translation of Soviet materials into English.

Perhaps I should mention, as further credentials concerning myself, that I have been in the field of Russian studies most of my adult life, mostly in government. In fact, so far as publications are concerned, it happens that immediately after the war I was with the American Embassy in Moscow as the representative of the Library of Congress and of other Government agencies for the purpose of improving and facilitating the receipt in this country of Soviet publications.

In subsequent years I have been doing research in that field and using the publications myself.

Senator LAUCHE. When were you in Russia?

Mr. RUGGLES. Between 1946 and 1948, sir.

Senator LAUSCHE. And you were attached with the United States Embassy?

Mr. RUGGLES. Yes, sir.

Senator LAUSCHE. Assigned the responsibility of developing ways and means of acquiring their research information?

Mr. RUGGLES. That is correct, sir. That was my principal responsibility. I was also cultural officer, which, because of Soviet restrictions, in those days didn't allow too wide a scope.

In discussing the question of translations I would like to make three principal points:

While translations are indeed important, unquestionably important, in assisting the American scholar in all fields to obtain access to the

results of research in the Soviet Union, I should like to assert—and I should like to adduce arguments to support the assertion—that they are certainly not the sole means, and in my belief not the primary means of obtaining such access to Soviet information. That is my first major point.

Secondly, I should like to suggest to this committee that during its consideration of this problem those institutions and those individuals who have been in this field for many years, and who are very experienced, should not be overlooked, and that their achievements not be ignored.

Thirdly, I should like to suggest that no one, whether it be Government or private enterprise, rush into expensive operations without first doing the necessary preliminary research into the nature of the problem.

If I may digress for a moment to illustrate that point, I should like to say that there has been testimony before this committee, and it has been on the front pages of the press in other connections, to the effect that the Russians are making tremendous achievements in the matter of bibliographic control of literature. It so happens that at the present time, because my time for this particular enterprise is very limited, I do attempt to keep abreast of what the Russians are doing by reading their own periodicals in this field.

I do not pretend to be an expert, because I have not had time to do the thorough research necessary on what the Russian scientific and bibliographical services amount to. I do, however, gentlemen, consider myself expert enough to tell you with assurance that the data that have been presented to this committee, and that we have seen elsewhere in the public press, are not based on real research, and therefore may be incorrect.

One of the points I should like to make is that we should study the Russian experience. We haven't. Maybe they are good in this field. I am not denying that they may be; they are good in many other fields. But we don't really know. And the study I recommend would not be a major research enterprise. It wouldn't take more than a year, probably it would take less; it wouldn't take more than $25,000, probably less, to get a good, clear picture so that we would know where we stand.

Similarly, programs of translation—and let me say that in my opinion they have been otherwise very well managed—have been launched without anyone making a study of what the scientist really needs, and how the scientist really goes about doing his research.

I should like to present some data in a moment which indicate that further inquiry along those lines should be made before decisions are made to spend great amounts of money for translations.

Representing as I do today the interest of librarians, I should like to suggest a few things that are uppermost in librarians' minds.

First of all, they consider it their primary duty—I am speaking of research libraries now—to serve scholars in all fields. They are willing and eager to provide those scholars with whatever is needed. They of course are willing and glad to take into their libraries and put on their shelves and process—which is an expensive business, by the way—translations, as well as originals, if that is what scholars really need.

But, as a custodian of recorded knowledge, the librarian must take a long-range view. These publications, you see, accumulate on his

shelves. They become something that he has to be custodian of for the rest of the existence of those publications, which is for many, many years.

And, he must make a choice, when it comes to translations, as to whether or not he must purchase both the translation and the original publication. The cost, of course, is greater in this case. Or should he buy just the translation? Or is he sure that the translations will really be needed, really be used? If not, should he get just the original? It is this kind of choice that he has to make.

As a manager of resources, which are always financially limited, he must consider the price, too. At the real prices of translation, the librarian finds them prohibitive. By "real prices" I mean before they are subsidized. As a rough estimate there are entering into this country each year approximately a million pages of material in the Russian language in the fields of science and technology.

It is estimated—again roughly but these are fairly well based figures—that it costs about $25 a page from the point of airmail receipt of the publication to the point of deposit of the translation into the post-office box of the recipient.

To cover all of the Soviet scientific and technical literature by translations—which incidentally no one suggest, or very few suggest, really—this is just an illustrative figure—would therefore cost $25 million a year.

A lot of service is being done, and incidentally largely by Government agencies, in getting translations of Soviet publications into the hands of scholars. There are at present approximately 50 Soviet scientific and technical journals being translated, most of them subsidized by the National Science Foundation and the National Institutes of Health.

These subsidies help the librarian considerably with his problems of costs. Yet when you add up the subscription prices for all of those journals, even with the subsidy, which in some cases cuts the price down to one-tenth of real cost, the total is $3,200 annually.

This, Gentlemen, represents at least one-half of the total annual budget for the purchase of all Soviet publications in any one of the majority of our large university libraries. It represents at least one-fifth of the budget for Soviet publications in any of the five largest American university libraries. It represents nearly one-eighth of the total budget of the Library of Congress for the purchase of Soviet publications.

The figure itself, $3,200, is peanuts.

Senator LAUSCHE. $3,200 for what?

Mr. RUGGLES. For the subscription prices for the approximately 50 Soviet journals which are now being translated.

The figure of $3,200 is peanuts by some standards, of course. But the total figure available to our largest research libraries for the purchase of Soviet publications is also peanuts, and therefore this question of price does have to be taken into consideration by the librarians as a very real problem.

The librarian also must necessarily take into account the continuity in his own resources, in his collection of materials. And he necessarily asks the question whether translations are a fad of the moment; are they stimulated by the appearance of sputnik overhead; can we be assured that the subsidy will last for years? This again bears on

the problem, for instance, as to whether or not he purchases the original as well as the translation, which adds to his cost, or whether he depends entirely on translation.

I have belabored that point, I am afraid.

Librarians again—this is my next point—as specialists in the research process and working hand in hand with scholars, learn as scholars do, of course, what the means are of getting at data, whether it be Russian or not. They are specialists in that field. They consider, as do researchers, translations to be important. They recognize, however, as do researchers, that translations are not the primary means of getting at Soviet data.

Other means must be supported at least as strongly—financially, I mean—and should not be neglected, namely, bibliographies, indexes, and abstracts.

Also, research should be supported—and much of this should be basic research—into means of using machines to facilitate our access not only to Soviet but to many other materials. At the present volume of receipt in this country of Soviet materials, machine handling is not particularly necessary. It would help, but it is not essential.

May I digress for a moment—this is outside the field of translation—I should like to say a word, if I may, about machine translation and machine handling of information. You have heard a good deal about the so-called library problem, or information problem. What you have heard certainly reflects—and I would like to underline that word "reflects"—a very real situation. The mass of data which is being published all over the world is increasing constantly at a frightening rate and, so far as the libraries are concerned, must be stored and accumulated so that year by year the access to those publications becomes more difficult.

You have heard about this again and again. However, in the process—in all frankness, gentlemen—you have been given much misinformation about the present functioning of libraries. Here, too, study and discrimination are necessary before decisions are made, in my opinion.

As for machines, the state of technoligy in this country has already without question reached the point where it can really help eventually in the solution of this serious problem that we are dealing with. No existing machine, however, can do it today. What is necessary is basic research. Most machines, advocated by some for immediate application to the library problem are either the same as or derived from—slightly adapted from—the great computers that have been so beautifully serving our scientists and mathematicians. But the nature of the library problem is entirely different.

I would like to cite an illustration which Mr. Taube, who testified here yesterday, made in an excellent article he wrote on the use of machines for handling information. He said something to the effect that you can travel to New York in an automobile, or you can travel to New York in a steam shovel. It doesn't make much sense, however, to travel to New York in a steam shovel. To use most of the available, highly advanced computer equipment that was designed for mathematical calculations, or for the handling of business records, to use those now, to try to solve the library problem, is just like riding to New York in a steam shovel.

So what we need in this field, gentlemen, is basic research before we make decisions about introducing machines into this area.

One more word by way of illustration. I don't know of a single existing "information retrieval" machine which can find a specific piece of data even one-tenth as fast as a human can. And I can't calculate the relative cost; the machine of today is enormously more expensive than the man-hours involved in doing the same job.

I have made this digression concerning machine handling of data because perhaps the rest of my testimony here might make me appear to be a traditional, fuddy-duddy librarian. I am not.

I believe machines will some day help us to solve this problem. But in the meantime we have to get at these data.

What I would like to do is to try to bring some commonsense to this problem of getting at the data in the meantime.

Could I present what follows in the context of two very simple premises. They are so simple that I almost hesitate to bring them up. But I think they provide a useful framework of discussion.

What are the purposes in our keeping up with Soviet developments? The first purpose is of course in the national interest. There is no need to elaborate on that; it is obvious. In my opinion, gentlemen, this is primarily the responsibility of the United States Government. In my opinion, further—and I think I speak in an informed manner here—the Government has adequate resources to keep up with those developments.

If I may speak personally for a moment, not too many years ago, when I was doing research with the Rand Corp., which works on contract for the Air Force, I worked in collaboration with a nuclear physicist Arnold Kramish, who also reads Russian. We wanted to trace the course of Soviet atomic development. What we discovered indicated clearly that if appropriate people had been reading the Soviet-published journals—I am not talking about classified information now—up to the year 1948, if there opinions had been asked by their bosses, if Government administrators had really been seriously interested at that time in how advanced Soviet developments in the atomic field were, those people who could read Russian and who were employed by the United States Government, could have told them. And we would not have been surprised at the first detected Soviet atomic explosion.

My point is that the Government has many very able people employed in various agencies who can read the Russian language, whose daily job it is to follow Soviet developments. And if the Government finds it advisable, as in my opinion it should, to keep in touch, to keep abreast of what the Russians are doing in any field, it already has the resources to find out.

The second purpose in keeping in touch with Soviet developments is to serve pure scientific curiosity and communication. This has to do with the free exchange of ideas in the scientific community, whether it be national or international. This, in my opinion, is the primary responsibility of the individual private scientists and engineer. The effect of what he finds out has obvious bearing on the national interest, but the responsibility, I think, is primarily his.

A couple of other rather simple propositions, if I may, Mr. Chairman.

What are the reasons for interest in translations? Obviously one is the belated recognition—and I am emphasizing "belated"—of Societ achievements in several scientific and technical fields. The other reason, equally obvious, is the serious deficiency in the number of Americans who know the Russian language.

If you would like, I could insert in the record some statistics on that subject. Are you interested?

Senator LAUSCHE. You might insert it without reading it.

Mr. RUGGLES. Unfortunately, here again I have only notes. I do not have a prepared statement.

Senator LAUSCHE. Proceed.

Mr. RUGGLES. A gentleman named Jacob Ornstein, who used to work for the State Department—I believe he is now at Harvard University—about 2 years ago made an excellent study of Russian research programs in the United States.

On the basis of his inquiry he estimates that there are only 4,000 Americans on the college level who can read the Russian language. By contrast he cites a figure of 10 million Russians who can read the English language.

There is a rather recent publication by UNESCO, which incidentally I would recommend to the attention of the committee. It is a very handy and informative handbook on the question of translation. It is called "Scientific and Technical Translating and Other Aspects of Language Problems," and it was published, I believe, in late 1957.

That booklet, with all necessary reservations about the nature of the statistics involved, estimates that there are about 905,000 scientists and engineers in the United States, of whom 1,000 can read the Russian language. That is about one-tenth of 1 percent.

By contrast—and this isn't a very impressive contrast, I must say—about 3,000 British scientists and engineers out of a total of an estimated 250,000—that is a little over 1 percent—can read Russian.

UNESCO further estimates that of about 1 million scientists and engineers in the Soviet Union itself, 500,000, or approximately 50 percent, can read English.

I cite these data merely as another indication of the reasons why translations are needed.

The next point is that while translations are very important indeed for the fields of science and technology, there has been in my opinion far too little recognition that translations and other aids to access to Soviet materials are needed in other fields than science.

The public press doesn't seem to recognize that Soviet politicians as well as scientists are well trained and very able. They don't seem to give much attention to the fact that if we were humiliated by the appearance of sputnik before our Explorer, we should have been at least as much humiliated by various diplomatic defeats we have suffered before and since. And we should be concerned, in my opinion, with the training of political scientists, economists, and other social scientists, equally as much as with natural scientists, and when they are trained they should have equal access to Soviet materials.

My next point is—and I hope by now that I have made it clear that I grant that translations are important—that these translations should not be supported at the expense of other means of keeping ourselves informed about Soviet developments.

No. 1, bibliography: With the mass of publications that are produced, unless a scientist knows that they exist, and can find them by author and title or subject, of course he can't use them.

In this field of bibliography there are many institutions that are outstanding. Above all, outstanding above all, Senator, is your own Library of Congress.

Second, indexes, which are a means of getting at the contents of those books once you have found them. Here again the Library of Congress is outstanding in its services not only to Government agencies but to the scholarly community throughout the United States.

I should like to invite your attention—I am sure perhaps you have already learned about it—but the fact that the Library of Congress produces monthly a volume this thick [displaying exhibit], which constitutes an index to the content of Soviet periodicals in all fields, and of titles of books and monographs in the Russian language received in this country. It is called Monthly Index of Russian Accessions. The list of books contained in here represents not only what the Library of Congress receives but what many, many other libraries also receive. (That is, it also constitutes for the monographs, a Soviet Union list of books put out monthly.) And if you will look at the index you will find frequent references to matters that we are concerned about and read about in the front pages of our daily press: Atomic energy, guided missiles, whatever you like.

Concurrently, the Library of Congress produces monthly a volume almost as thick covering all publications received from other East European countries. Its title is "East European Accession, Index."

The number of monographs, books, covered by the Russian index alone, last year—these are figures as of the end of March—was 11,209 in all fields. The number of periodicals that were indexed by reference to the subject of each article in those periodicals, in the fields of pure science was 962. I am talking of issues, not titles; issues of periodicals. The number of issues of periodicals covering the field of technology indexed in this journal in the year ending March 1958 was 1,938.

Also extremely important, Mr. Chairman, are the abstracts, I brought with me data to illustrate this point, Mr. Chairman, but I have heard such good testimony from the representatives of Chemical Abstracts and Biological Abstracts that perhaps I can spare you these data. The fact is that these are an extremely important means of getting at the content of Soviet publications.

Senator LAUSCHE. That has been covered, I think. You can move on to the next topic.

Mr. RUGGLES. There is just one point. The data that you have been given by the representatives of these two organizations have been, I believe, for the most part current. What I should like to emphasize is that they have been covering Soviet periodicals for many, many years. They discovered that the Soviet Union existed long before sputnik.

Another area which should not be neglected at the expense of translations is the teaching of Russian. By way of illustration, crude illustration, of the costs involved if you took this total annual cost that I cited earlier of $25 million to translate all Russian publications—which nobody suggests, I admit—nevertheless, if you took that figure

and applied it to the teaching of Russian assuming about 15 students per class, and assuming a realistic figure—they are underpaid—of between $4,000 and $5,000 for the Russian teachers—you could train within a year (and a full year's training gives an awfully good basis for reading at least scientific and technical Russian) somewhere between 75,000 and 100,000 people for the same cost.

I would suggest that in any event that people of the United States, with the shrinkage of world communications, and with our greatly increased responsibilities are simply going to have to learn more languages than we have in the past. We are practically monolingual, which is not true of most other nations of the world.

Also speaking from experience, Russian is not terribly difficult to learn. It is a lot less difficult than some things many people do for recreation nowadays. And when given the opportunity, Americans of all ages really learn quickly, and with interest.

In that connection, I would like to cite a recent article which perhaps you saw in a local newspaper, about the experience in Schenectady, N. Y., in which there is a television program——

Senator LAUSCHE. I don't think it will be necessary to go into detail on this item.

Mr. RUGGLES. All right, sir.

In conclusion, about language training, I have discovered and my colleague has discovered in our visits to various universities throughout the country, that there are some Russian-language-training programs directed at technicians, at engineers and scientists, which have been proving very successful.

Despite its importance, the translation of Soviet literature has certain drawbacks which I think should be recognized clearly. In the first place scientists as well as the rest of us are already swamped by literature even in their own language—in the English language.

There is no assurance—and this is where a study of the actual research habits of scientists that would test this point comes in—there is no assurance really that they would read the translations even when provided.

By way of example, of these 50 Soviet periodicals that are already being translated, not a single one of them has a circulation of as much as 1,000. That is an awfully low figure. It does not indicate that there is great demand for them.

Secondly, translations will never serve scientists in one of the most important means they have of communicating their ideas internationally, and that is person-to-person conversations with colleagues in the same field.

Finally, translations—and my statement is based on testimony of scientists and engineers all over the country with whom I have talked—translations are no good at all; they don't serve any purpose; unless they are done by experts in the subject matter. These experts are not easy to find. A man who is a specialist in nuclear physics and who happens to know Russian, would usually much prefer to spend his time doing research in nuclear physics rather than translating journals on the subject.

We do have some examples of how scientists actually go about their work in the form of one study. It is the only one I know that exists, and it covers only one field of scientists; namely, medical scientists. This study was done by Saul Herner. I understand it will appear in a forthcoming issue of the magazine Science.

This study shows that while only 6 percent of his sample medical scientists can read Russian, over 50 percent of the ones he interviewed —and this was a scientifically designed sample—over 50 percent had made some use of Soviet-published information in the previous 6 months. And these data agree with my own findings which, however, are impressionistic rather than on a sample basis.

What was their primary means of access to this Soviet material? First of all, indexing and abstracting publications. Second, footnotes and bibliographical references in English-language materials. Third, unsystematic browsing through English-language publications in which Soviet developments were discussed.

I would draw your attention to the fact that in this study the means of access of medical scientists to Soviet literature did not include translations, even though they existed at the time the study was done.

In my own study I was told by several scientists and engineers that the best means they found of getting at Soviet literature was to have a translator available on the staff, someone who knew Russian, who also knew their subject matter, to whom they could assign the job of going through the literature, keeping track of what is going on in the Soviet field and bringing it to their attention. This they found to be the most efficient means.

I would like to submit, Mr. Chairman and Senator Martin, that what I am really getting at is that the handling of translations should be a matter of good commonsense and sound management.

The question really is, What is actually needed? We don't know yet. What is actually needed, and what are the most efficient and economical means of achieving what is needed? We haven't even asked the right questions, let alone answered them.

Instead, we have launched into certain programs that are rather expensive. For instance, some indiscriminate cover-to-cover translations that were designed to solve problems that were only superficial and not studied.

Finally, there has also been a tendency to overlook the greatest resources that are already available in great institutions. Again let me mention the Library of Congress as outstanding among these. There are also able people who have been working in this field for many years. And these people, let me add, are as cognizant as anyone who has appeared before this committee of the inadequacies of the traditional library systems and are interested in improvements, whether by machine, new systems, or whatnot, to improve the services in which they are engaged.

Gentlemen, that concludes my testimony except for a series of recommendations.

Senator LAUSCHE. Proceed with them.

Mr. RUGGLES. 1. Recognize the resources and past achievements of those organizations which are well equipped to solve the problem.

2. Strengthen these organizations with guidance, and necessary finances, including encouragement to them to experiment with advanced techniques, and in the hiring of competent staff to handle these techniques.

3. Encourage and strengthen financially those existing organizations which are capable of discriminating between research projects proposed, and capable of supporting research. By way of example, I cite an outstanding one, the National Science Foundation.

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In my opinion the research that I refer to should begin with the following fields:

1. What do researchers really need?
2. What advanced means—including electronic and mechanical—are necessary to fulfill these needs?
3. What are the real capabilites of the Russian bibliographical system?
4. Strengthen, through subsidies, existing indexing and abstracting services and make it financially possible to launch new ones.
5. Give more attention to needs of scholars in fields other than science and engineering.
6. Increase somehow the number of subscribers to existing and future translations in all fields.
7. Make available to the public a large quantity of translations which are and have been for years done in various Government agencies.
8. Stimulate the teaching of Russian in schools at all levels.

Those, sir, conclude my recommendations.

Senator LAUSCHE. Senator Martin?

Senator MARTIN. I am sorry that I had to go out of the room during a part of your testimony. I understand from what you have said here during my presence that the conclusions you enumerate here indicate that there is more need for accurate understanding of translations in dealing with the Russian documents that are available?

Mr. RUGGLES. Yes, sir; more understanding of what researchers really need before you expend money on translations or other services to satisfy that need.

Senator MARTIN. How large a team would it take to handle the total Russian document load?

Mr. RUGGLES. Do you mean to bibliograph——

Senator MARTIN. For translation and handling of those documents in your suggested operation.

Mr. RUGGLES. I am not suggesting an operation, sir. What I am suggesting is a small-scale study of what is needed before additional funds—there already are funds being expended—before additional funds are expended on translation or anything else. This particular study, Senator, would take 2 very competent people, only 2, for a period of 6 months to a year, full time. That is all.

Senator MARTIN. Was it your idea that they should be Government employees?

Mr. RUGGLES. I don't think it makes any difference, sir. There are able people in Government; there are able people outside of Government. It is a sort of study that I should think typically might be financed by the National Science Foundation, for instance, or by my own organization, for instance.

Senator MARTIN. You prefer to have it outside of Government?

Mr. RUGGLES. That is not very important to me, sir. I don't think it makes a lot of difference.

Senator MARTIN. I missed part of your testimony as I was called out of the room and I am trying to piece it together.

Mr. RUGGLES. I have not taken a stand pro or con, and this is simply because I have no feeling in the matter. I have worked in Government, I have worked out of Government. I see no essential difference.

Senator MARTIN. This phase of your recommendations can be handled, as far as Russian documents are concerned, by two experts?

Mr. RUGGLES. That is a rough guess, Senator, and I base it on my own experience. I myself have been conducting, with a very able colleague, a study of a related aspect of this question. We began the study last September. This is a wholly extracurricular activity of mine and of my colleague. He teaches full time and I work full time. We began it last September and we will finish it next September. And I am immodest enough to say that I think this is going to be an awfully good study.

Senator MARTIN. This is quite a different problem than I first pictured it. I thought you were talking about a very large organization.

Mr. RUGGLES. No, sir. Senator, there is a very great difference between the cost of studying what should be done and the cost of developing the means to get it done. The latter can be terribly expensive. What I am suggesting is that you don't throw the money into the second before you do the first. That is all.

Senator MARTIN. Your suggestion is to have this thoroughly developed as an idea before we start putting it into being?

Mr. RUGGLES. Yes; to know what the problem is. We really don't know what the problem is.

Senator MARTIN. How long do you think it will take to do this preliminary work?

Mr. RUGGLES. My guess is a year, with a couple of very able people, full time, for each separate question enumerated in my recommendation.

Senator MARTIN. That year would be well spent as far as making our approach to it more workable and more practical?

Mr. RUGGLES. Senator, that is the major burden of my testimony. Yes, sir; I certainly do think so.

Senator MARTIN. I gathered that from the beginning of your testimony and from the end.

Mr. RUGGLES. It was at the end, too.

Senator MARTIN. That is a very real contribution to us at this point. I am of the impression myself that we should do some real studying before we make too definite a move. I don't know how long it will take. I think we should know what is wise for the first move. I want to go over your suggestions very carefully before I do too much else in the program.

Mr. RUGGLES. Thank you, sir.

Senator LAUSCHE. How many pages of Russian material are we getting now on these scientific subjects a year?

Mr. RUGGLES. As a rough guess, Senator, about a million pages per year.

Senator LAUSCHE. Have you any idea of how many pages are now being translated?

Mr. RUGGLES. I am sorry, I don't have the number of pages. But if you take approximately 50 journals and approximately, on the average, 200 pages per journal——

Senator LAUSCHE. That would be 10,000.

Mr. RUGGLES. 10,000.

Senator LAUSCHE. And your suggestion is that before we establish a definite program we ought to know the limits of what we ought to

do on an intelligent basis, seeking to achieve the objective of using to the best advantage the usable material which we can get from it?

Mr. RUGGLES. Yes, sir.

Senator LAUSCHE. And before that is ascertained, you don't feel that we ought to plunge into any type of program?

Mr. RUGGLES. Well, sir, we are already in the midst of a program. What I am suggesting is that we not throw large resources into new ventures until we study the problem more thoroughly. Also, I am testifying here, after all, just on the question of translations.

Senator LAUSCHE. I think your testimony has been excellent because if one would form judgments based upon what was said in the newspapers, we would have hysterically run to translate 1 million pages a year.

Mr. RUGGLES. Yes, sir; that is my point.

Senator LAUSCHE. That is fine. Thank you very much for your help, Mr. Ruggles.

We will hear one more witness, Mr. Lawrence H. Flett, former director of the new products department, National Aniline Division, Allied Chemical & Dye Corp., New London, N. H.

Mr. Flett, we thank you for coming here and we will be delighted to hear you.

STATEMENT OF LAWRENCE H. FLETT, FORMER DIRECTOR, NEW PRODUCTS DEPARTMENT, NATIONAL ANILINE DIVISION, ALLIED CHEMICAL & DYE CORP., NEW LONDON, N. H.

Mr. FLETT. As you read, I am Lawrence H. Flett. I am here somewhat like a fish out of our cold New Hampshire waters, suffering from the heat and feeling thoroughly out of place.

I am not the person who provides the information. I am the kind of person who uses the information. I am on the other end of the deal, and I came down here with the thought that perhaps you might like to have that viewpoint.

I am a creative chemist. There is no doubt about the success of my methods. I have products in commercial operation which are doing people a lot of good. I have 75 patents. I have been recognized for my accomplishments in science by the Schoellkopf Medal of the western New York section of the American Chemical Society. I recently received the Gold Medal of the American Institute of Chemists—of which I have been president—for my accomplishments in science and for my accomplishments of the human side of science. When I say the "human" side, we are not concerned about the shortage of scientists as much as we are finding jobs for scientists.

Primarily I speak for the chemists. I shall try, as far as possible, to avoid telling you the things which you have already indicated today, that you have accepted. In other words, that we are approaching a morass of information. I think I can point out to you what might be helpful to you: how it happened, what it is leading to, what it costs you, and possibly give you some idea as to what you might do about it.

Chemists are the people who are representative of the scientists who use your information. I have been the head of many chemical organizations, including the Institute of Chemists, and I am familiar with them. I know the scientists, I know the bulk of the creative scientists. There are relatively few of them. I will come back to that later.

I started chemistry just about 40 years ago, when I was graduated by MIT. At that time, in the classical European style, you made a complete search of the literature, something which would be impossible in certain fields today. From then on you followed chemical abstracts and you kept yourself posted.

The bulk of our literature was German. I was one of the group that was called upon at the time of the First World War to establish the American dye industry. And it is the American dye industry, from which the great chemical industry which gives us our wonderful miracle products of today, has developed. And it has developed since that period, and that is what has given us health, happiness, jobs, and business.

That was a very happy state of affairs. But along about the middle thirties the ability to do that had disappeared. The average chemist, I regret to say, solved his problem by stopping reading. I solved my problem by bringing in a man devoted to information, and that has become standard practice.

Research originally was carried out completely by one man. He developed the product, he did everything, he took it into the plant and he sold the product. By the middle thirties research had begun to be well organized; at that time you put as a working part of the group a man whose job it was to get information. Certain companies developed information groups, a procedure which is a little hard to explain, that has been of great interest to scientists. The late Dr. Egloff and I organized a research conference on Information in Action, in Detroit, for the American Chemical Society, at which we had 750 people. That may not seem like a lot, but in terms of chemistry that cost the industry and the schools about $100,000. The interest was very great.

The information group will take care of the information problem up to a certain point. But we have now reached the stage where it can no longer handle it. We face the situation as you have already pointed out, where we are going beyond human means to cope with the problem and we need mechanical means or some other device. We need the same kind of a breakthrough that we had back in the 16th century when we had been writing books by hand and started to print them. We need that kind of a break through to get the information to the chemists.

It seems to me—and I can only surmise things by things that are said—that perhaps there is some misunderstanding on this matter of information. Chemical Abstracts is a wonderful index. It is superb; it should be supported in every way, but when we speak of information in our business, we don't mean something to replace Chemical Abstracts. We need something over and beyond Chemical Abstracts.

If you are hungry and need food and have pennies, you can't eat the pennies, but you can take the pennies and buy food. In part of the country you might have to walk a very long ways. Indexes are that type of thing. They are not food; they are means of getting it; food for thought.

My problem is not to replace the index but to get the information which the index relates to, to the chemist. Creative chemistry is based on invention and discovery. Invention and discovery are made by people who have put a tremendous amount of study and thought into a field. They are not drawn out of thin air by novices. They are the product of information.

I don't want to take the time here to go into how invention is made. As expert in the field I ask you to take my word for it. You must have information.

Now with this great mass of information, you have two problems. One is not to get the references to the chemist, but to get the information in the reference to him. The other problem is to protect him against the horde of information which he doesn't need. In other words, there must be a selection of information. He doesn't just want information. He wants particular information. That is where this information group came into being. It was a dynamic thing and replaced the old static and basic literature made search before one started. The chemist wants information and when he wants it he wants a particular kind of information. That is the No. 1 problem.

Now, what is it costing? I don't speak for the various organizations of which I have been head, but the things that I am telling you I have said publicly, and they have not been contradicted. So on that basis I would ask you to accept them.

I have talked to many people who know research. The average such person says that the efficiency of research is 15 percent. That is extremely low. And in my opinion that figure is high. The highest figure that anybody has ever given me who is familiar with his subject is 20 percent. Actually, the average would be below 15. But more people would say 15 than any other figure.

What is this other 85 percent? What is the breakdown on that? Ten percent—and that is a modest figure, I think—is out and out duplication of material which has already been prepared. Anybody who is familiar with patent matters—and I have 75 of them—knows that time and again when a patent goes into the office, the identical information is found in the literature, although the person is presumed, as far as he is concerned, to have invented it. Ten percent out-and-out duplication; that is, 10 percent against 15 percent of accomplishment. That is no small factor; 35 percent by lack of information. In other words, that is work which men did which they would not have done had they known what was already in the literature. They could have had the information which was available, if they could have pulled it out by some device.

They certainly could not pull it all out by human means. Forty percent, which brings up the remainder of the 85 percent, is one of the most annoying things, and I hope that your committee will give consideration to it. It is the matter of communication. It is either the lack of proper definition of what is trying to be done, or the lack of proper understanding.

In other words, maybe the fault is one the part of the chemist or maybe the fault is on the part of his organization. But there is a breakdown there in communication which represents a 40 percent loss in effort.

You talk about the present shortage of chemists. You are not going to suddenly alleviate the shortage of chemists. I made a statement out on the west coast which the television stations thought enough of to put all over the west coast, and that is this: "You show me a great chemist, and I will show you a great teacher behind him." So suppose you want to make more great chemists? Where are you going to get great teachers? You are not suddenly going to educate more chemists to alleviate the shortage.

If you are going to alleviate it you are going to do it by making better use of the chemists you have.

One of the best ways and one of the easiest ways to make better use of the chemists you have is to give them the information that they require—a fairly simple device but one that requires a tremendous amount of work. You are embarking, believe it or not, on what chemists would know as a research project. In other words, you are spending money as a means of making information available to chemists. We would call that research.

I have known J. W. Perry for quite some years, and I would estimate that Perry has been working on the information problem for 15 years before he finally got a breakthrough. If you have any idea that you can spend $200,000 or $400,000 and in a year get a mode of providing scientists with just the necessary information, you will be looking for the greatest bargain that the United States of America ever saw. To get that down to dollars, there is about $6 billion spent on research. I am a chemist and the chemical industry spends about $600 million.

If you have say 10 and 35 percent—forget the other 40—that is 45 percent of $600 million. It comes pretty close to $300 million a year that you are talking about. That is the kind of thing that you are going to spend money for. That is the kind of thing that makes jobs and makes business.

In my eyes the great accomplishment of industrial chemistry has been to bring to the people things which were once reserved for a privileged few; things which once only kings enjoyed now can be enjoyed by the ordinary man. You have health beyond anything you ever imagined. For example tuberculosis, the great killer of my youth, has disappeared today. You don't hear anything about it. And it is through chemistry.

Your fine clothes, your fine shelter, your fine automobile, and its fine performance are products of chemistry.

Chemistry and science have brought to people the comforts of life. They bring happiness, they give us a standard of living beyond our neighbors.

One of the finest things I think that the United States has done has been to try to bring to other countries the degree of prosperity which we have here. And that degree of prosperity is largely based on an industry much of it on the chemical industry. The greatest defense weapon which we have in the United States of America is our ability to produce, because it doesn't matter whether you can make a machinegun. If you can only make one of them, the man who can make a hundred million bows and arrows are going to win. It is production which is necessary.

There is some tendency nowadays to belittle our American scientists I think they are great. There is nothing in the world to compare them with in spite of the increase in science of other nations, which have not shown their progress by bringing things to their people.

I believe that time will come. Russia is educating everybody in the field of science. I listened to the program Report Card, 1958, and was so happy to hear that at least one community in the country was starting science in the kindergarden, and in a very lively and interesting way.

We in the field of science would like to see everybody educated in science. We would like to see a greater interest in it. We would like to see a far better liaison than exists between people in government and people in science.

When we go to Europe we find such bonds are very close. When I go to France I am honored by being asked to assist the Minister of the Interior in the opening of the chemical exposition. When we go to Athens the mayor is with us, in a very real sort of way. Wherever we go, the government is very close to chemistry.

Here in the United States there have been several examples of close cooperation. But in general it is missing. I hope that one thing that your bill will do will be to bring a far better collaboration between science and government.

Now with respect to the means by which you are carrying it out: I have been in research for many years, and you are going to enter a research project. I would make two suggestions. One, do not set up buffer groups between yourself and science. They always dilute, spoil, and blunt the purpose.

Two: Don't centralize. When the newspapers are crying very loudly about centralizing, the very brilliant research organizations, with tremendous accomplishments are hard at work decentralizing. I would recommend that you do your best to decentralize the effort and spread it around, and wherever there is paydirt, get it there. Have no doubts or lack of faith in the future of our science.

The United States has problems. We have serious problems. We have the problem of water. Certain communities are already purifying sewage and putting it back in the water pipes because the water problem is so acute. Although we are very comfortable in our ability to produce in the agricultural areas, there is not a great margin of good land for agriculture. If our population went up 20 percent, and if we had no advance in science, we would pay more for our food. We will have an advance in science. Have faith in science. I am sure that what Congress is going to do with this bill will be a very wonderful contribution to the future of science.

I came here to be of what help I could.

Senator LAUSCHE. Thank you very much.

Senator Martin?

Senator MARTIN. I would like to know just what phases of this general problem you think we should embark on in this proposed legislation and include in this Government approach? Where would you suggest we start?

Mr. FLETT. I would like the bill very much as drafted. It seems to me more a case of the carrying out of the bill as it now exists.

Senator MARTIN. I didn't hear you.

Mr. FLETT. It seems to me the problem is more a problem of the means by which the bill as it now exists will be carried out. In other words, you are set up now to either do things by the Government—and there are certain things that you might want to do by government—or by other organizations, and certainly you would want to do them in other organizations.

For instance, with Chemical Abstracts money has always been a problem. These people work, and we chemists pay our money to provide something from which the whole country benefits. Chemical Abstracts could do a better job and life would be much simpler and

more rewarding if they had some assistance from the people of the United States who are the people who have really benefited from Chemical Abstracts.

Senator MARTIN. This work of abstracting, or cataloging, or indexing, or research, or translation, would you include them all in the encouragement?

Mr. FLETT. In my book, and in the field of chemistry, Chemical Abstracts is thoroughly adequate. They carry on their own research. When there are better ways to do it I think that they will provide them. I think it would be a great mistake to try to lift out of Chemical Abstracts anything they are doing.

What I am pleading for particularly is not improving the abstracting service but improving the means of getting the information to which the abstracts refer. Abstracts are not information. They say, for example, that in Berichte, volume 2, page 247, you will see something there that may be interesting. That is all the abstract says. The chemist can spend years going through the abstracts looking up those pieces of information. But if he has a job to do in the laboratory he can't spend all his time in the literature.

Senator MARTIN. Government activity in this field of communication would not run against the agencies that are already engaged in the general field of science, in this communication phase of it? They would be free from danger of interruption or interference with any professions in its present operation; is that right?

Mr. FLETT. If I understand you correctly I think very much a project should be set up in the matter of communication, which is a very serious problem. Those kinds of studies are unrewarding. If one wants to develop a new plastic it is very rewarding and nobody needs any assistance from anybody in doing it. As a matter of fact, it becomes a contributor to the United States Government. Things like information and information research are not rewarding. Because they are not rewarding we don't have enough people interested in them. The few people who are interested in them are forced to spend time with unimportant phases when they should be using their ingenuity in a more advanced way. In that the Government support could render service to chemists and people.

Senator MARTIN. I believe you said communication accounts for a loss of some 40 percent?

Mr. FLETT. Yes, sir.

Senator MARTIN. That would be a sizable contribution, if the Government entered into that field with some real technical means of assistance to the whole world of science. That is a rather worthy objective free from possible head-on collision with the science world.

Mr. FLETT. It is hard, in a brief time, to cover something with which we have been working for many years.

Let me point out that those figures I gave you are the figures of today. And I should have made it clear, which I didn't, that from now on that return on time spent in research will be far less. In other words, as the literature gets much too deep to handle, the repetition of the work in it will just increase, and as the repetition increases the efficiency of research will go down.

But, yes; you are very right; I would not argue that 40 percent was not as important as 35 plus 10. But I would hope that you might give consideration to both.

Senator MARTIN. I did not have in mind communication to the exclusion of everything else. I wanted to know on what you put your major emphasis. That is a new thought that I hadn't received from the other testimony.

Mr. FLETT. What is that?

Senator MARTIN. This phase of the testimony is different from the earlier testimony from other witnesses. It brings in a little different light to me.

Mr. FLETT. That, sir, is why I came down. I am the user of information. Such inventions as I have made have been by study. The true chemist loves to study. Every great scientist, every creative chemist I ever knew, was a great reader and a great follower of the literature. In my career I have done my best to do everything I could to contribute. I have been a friend of the library at MIT, a friend of the Hooker Kresge Library, one of the group who organized the Gordon Research Conferences. In chemistry we do a piece of work, we check it and recheck it and 6 years later we publish it. The Gordon Research Conference meets to discuss what we are doing now, which has become of worldwide importance and brings us people from all over the world.

An interesting point, there is some question as to just what is meant by basic research and applied research. There are many definitions.

To many people basic research is the organizing of information. In other words, if you can get a formula to describe properties, you could, with one page of formula, take care of seven volumes of critical tables. The bringing of information together into laws is really what most people consider basic research.

In Europe I have been through a number of their laboratories, they go in for what is frequently referred to as basic research. In other words, Caroother's work on nylon is often called basic research. The European chemists for example don't take a simple view of how can we take a refrigerator and make it better, but are concerned with whether this method of freezing by compression and expansion is the best method or could there be a better way of doing it than that? The pneumatic tire, can't we get something better for an automobile to ride on than a pneumatic tire? That attitude is very strong over there. They are very devout scientists, they spend much more time at research than we do; their spirit is very wonderful.

I think in the European laboratories you can look for important breakthroughs on a number of things that we have been working with.

Senator MARTIN. In the matter of communications, it would help us a bit in getting some further benefits from the experience of other people, I take it?

Mr. FLETT. I missed that; I am sorry.

Senator MARTIN. I say your suggested activity in the field of communications could be very helpful to us in advancing our contacts with and benefits from other countries as we go forward.

Mr. FLETT. I spoke about the fact that when I started chemistry my reading was mostly German. That is the basis on which we set up chemistry in this country, organic chemistry. During the period of the 30's the Germans had been fighting; the French had been fighting; and we had very little to worry about in the foreign litera-

ture, and chemists promptly stopped studying languages. My daughter was urged in school to not take up German because it was a dead language. Now things have changed and there are great developments taking place abroad.

It is safe to say that every European scientist reads English. We know they get our periodicals and we know they go through them very carefully. Over a long period of years, if they read everything we do and we don't read their material, and I look askance at mechanical translation; it is a beautiful thing but there is sometimes as much in the way words are written as in the way music is written—if they continue to study English and we refuse to study their language, they will surpass us.

Don't get upset by that. The fact that somebody surpasses us doesn't mean that we lose anything we have. It just means that we can look to faster advance there than we can here. If we don't do something about it I think they will surpass us.

The idea that every new thing is developed in the United States is a very wrong idea. A great many of our things have been developed abroad.

Senator MARTIN. That is very interesting. You have had a lot of practical experience.

Senator LAUSCHE. Mr. Flett, now that we are going to conclude this hearing, I would like to go through the bill not only for the benefit of Senator Martin and myself, but for the benefit of other witnesses who have testified.

The bill contemplates the establishment of a new department of government, and that is the United States Department of Science and Technology. I am now reading from the top of the second page, section 101.

It creates an Under Secretary and Assistant Secretaries. It gives the Department a seal, as set forth in section 104. And then it gives the Secretary, in section 105, the power to delegate a part of his authority.

Now we come to the important parts, as far as I can see it.

Section 106 provides:

> The National Science Foundation, together with its personnel, property, records, obligations, commitments, and the unexpended balances of its appropriations, is transferred to the Department * * *

Section 107 provides:

> (1) All functions of the Secretary of Commerce with respect to the Patent Office are transferred to the Secretary.
> (2) The Patent Office is transferred to the Department.

I will skip the subparagraphs and go to (b) (3), at the bottom of page 4. That paragraph provides how the new Department shall function and what it shall do:

> The Bureau of Technical Services shall have responsibility for—
> (*a*) The development of a complete science information program, utilizing all facilities of the Federal Government now vested in agencies which operate related programs;
> (*b*) To acquire, in cooperation with other public or private agencies, scientific literature, both from foreign and domestic sources;
> (*c*) To establish necessary facilities within the Bureau, or in other public or private agencies, to collate, declassify (subject to the requirements of section 5 of the act of September 9, 1950 (64 Stat. 823)), translate, ab-

stract, index, store, retrieve, and disseminate information essential to the development of scientific and technological programs as may be determined to be in the national interest and consistent with security requirements * * *

Let us stop at that point. Should we come to the conclusion that this new Department shall engage in all of these operational activities?

Mr. FLETT. I believe that they are all a logical part of that Department. The National Science Foundation certainly has a very distinguished record and has been a very useful and powerful group.

Senator LAUSCHE. That is, it shall translate, abstract, index, store, retrieve, and disseminate information. You feel it should do that?

Mr. FLETT. I feel that that would be a very wonderful thing for the new Department to do, because our problem is still to get information. This is the dissemination of information, not the dissemination of abstracts, not the dissemination of references.

Look at it this way, Senator: Suppose a man is sick. You don't cure him by giving the doctor references in the literature to all of the known diseases, and references to all of the pharmaceutical products. He would just have millions of references. They would be useless. But by mechanical means you could pick out the particular information he needed and the particular product he needed to cure him.

Senator LAUSCHE. Do you interpret this language to mean that we will only provide index information and catalog information?

Mr. FLETT. No. "Disseminate information essential to the development of scientific and technological programs."

Senator LAUSCHE. According to my understanding this Department would undertake the complete operations of storing, indexing, collating, retrieving, and disseminating information.

Mr. FLETT. I am not a legal man. The way that reads to me is that they are going to do all of those things. Obviously, they can't do them all at one place.

Senator LAUSCHE. It has just been pointed out, and I understand that to be the fact, that we may choose other public or private agencies. But it does give the Secretary of the Department the power to function fully in this manner.

Now, my query is, What will become of all the other private agencies that we have if he does do this?

Mr. FLETT. I assume from my reading of the bill that he will function to a large extent through private agencies. In other words, that as far as chemical indexing is concerned, he will function through Chemical Abstracts.

Senator LAUSCHE. He will have that right, it is true. But he will also have the authority to do the work himself.

Mr. FLETT. I think we have to have some faith in our officials. There is no other way we can do it.

Senator LAUSCHE. Paragraph 4, under section 107, gives him the authority to do research work in the development of mechanical devices that shall aid in indexing and cataloging.

Going to page 6, (c) (1)—

the National Bureau of Standards is transferred to the Department * * *

Going to section 8:

The Atomic Energy Commission, together with its personnel, propery, records, obligations, commitments, and the unexpended balances of its appropriations, is transferred to the Department * * *

The Smithsonian Institution, with respect to certain of its functions is transferred.

Do you still feel that it ought to go that far?

Mr. FLETT. Those are scientific organizations. It seems to me they logically belong in this group of organizations.

Senator LAUSCHE. I am going to go a bit further, though we are not in on this.

Title II, page 10, authorizes the establishment within the Department of national institutes of scientific research.

Section 202, on page 11, reads:

> The Secretary is hereby authorized to establish, or to support the establishment of, one or more research centers or institutes in each of the following fields: Mathematics; engineering, the physical sciences, to include but not limited to, physics, chemistry, astronomy, geophysics, oceanography, and meteorology; the biological sciences; and the social sciences.

Do you feel, Mr. Flett, that the Federal Government should get into that field of activity at present, having in mind what is now being done by our scientific research institutions, and so forth?

Mr. FLETT. There are many problems, as I pointed out before, which are not profitmaking problems. For instance, the matter of water. This water problem is serious. People don't like this reprocessed sewage, and you can't blame them. And still it is a long-range problem. It is the kind of a problem that doesn't show up in New Hampshire, doesn't show up in Minnesota. It shows up down where they are having droughts. Those people down there haven't the money to support the necessary research to take care of it. And it seems to me that that type of thing is very admirably taken care of by Government organization. Certain of the agricultural work could certainly be taken care of.

I would like to see— and I don't think it could be written into a bill— a better liaison between the scientists and Government such as we have in other countries.

I would hope that if you set up such an organization that there will be a very close liaison between the scientists and the Government, and the scientists in industry and in the institutions and universities.

Senator LAUSCHE. While we have not had assigned to us the study of this subject I will nevertheless ask you the question: Title III on page 13 provides a scholarship-loan fund. I think it recommends $40 million for 1958, $60 million for 1959, $80 million for 1960, and $100 million for the years from 1961, 1962, 1963, and 1964—for each of those years.

I think it limits the loan to $1,500 a year for students studying in the science field. What is your opinion on that phase of the bill?

Mr. FLETT. That is a very controversial subject. I would like it because, to my notion, it will do more good than harm.

The other side of the question is this: Boys who go to school, who really have capabilities, hate to borrow money because it involves paying it back. And it involves paying it back at the low point of their career, and it involves paying it back with income taxes. At one time—I think times have changed now—at one time, MIT, which was one of the first groups to set up a loan program, found their loans going begging because the students felt that if they couldn't get a fellowship they would rather not take the chance.

A young man goes into science for one reason: he goes into it because he loves it. For the average scientist, when you figure what he spends on his education and the rewards he gets for it, there are a great many of them never get their bait back. There is only one way to really get the kind of scientist you want for creative work and that is to get him interested. If he is interested he will put himself through college. That is the other side of the question. Nevertheless, I favor the proposal, but I would like you to know the other side of it.

Senator LAUSCHE. I think it provides an interest rate of 2 percent, which is quite moderate. I had the thought that if you start financing students in sciences, how are you going to escape financing them in other fields?

Mr. FLETT. I would like to point out one more thing, if I may, and that is this understanding of a chemist. When you talk about information of the chemist or the scientist you are thinking, as I see it, in terms of the laboratory man. A chemist occupies many places in industry. He may be a purchasing agent who needs chemistry to know where raw materials are available; he may be in marketing; he may be the company president; he may be the comptroller. In all branches of the company you find chemists and they all require information, and different kinds of information.

And in industry, when you start a new project, it goes from desk to desk and it accumulates information, and each person that signs that needs a different kind of information to sign it with.

So to call a man a chemist is a little bit complex. I think perhaps your thinking is straight on it. I just wanted to clarify it.

Senator LAUSCHE. Senator Martin, are there any questions that you want to ask?

Senator MARTIN. We are not charged with title III, but I was interested in your response anyway. Title III is in the jurisdiction of another committee.

The bill we have before us is not necessarily in its final form. It will be revised again and again. We need all the advice and counsel we can get from all the witnesses here. What changes they might suggest in this bill as it has been introduced and already revised once, the chief clerk of the committee informs me, and which will undergo further revision, without any doubt.

Mr. REYNOLDS. This is only a staff presentation for study purposes. The committee has not expressed its view on any of its provisions.

Senator MARTIN. I was afraid we might give the impression that this is something we were raring to push through right now.

Our staff has been grand and has put in a lot of time and work on this. Its study was to get something before us. They have done a good job of that. But they don't represent that it is a finished product at all. We need the help of all of you, and any suggestions about changes in the bill as it is now before us.

Mr. FLETT. I didn't want to give the impression that I was in favor of tearing any part of it apart. I think basically I like it, and I think scientists will.

I would like to make one further point. I very much like the money spent on foreign associations. I have been associated with Societe de Chimie Industrielle which is one of the most important international chemical industrial organizations. They have been kind

enough to honor me by making me a member d'honeur. The association with them has been wonderful. The inventor needs different viewpoints. He can bog down in a place, but if he can just get over in another area and look at his studies from a different angle, all of a sudden everything becomes clear. It is so important to get these different viewpoints and to get these contacts from these people abroad. They are most cooperative. When they take you through the laboratories they leave no single door unopened. They make a fetish of it for fear that you might think they are hiding something behind it. They are wonderful.

Senator LAUSCHE. Thank you very much.

Mr. FLETT. Thank you, gentlemen.

Senator LAUSCHE. This will close the hearing except for further written statements that may be submitted. We will, however, also hear from representatives of the administration some time in June, as soon as they are ready to submit their statements and recommendations based on the evidence that has been introduced at these hearings.

The meeting will stand adjourned.

Thanks to all of you for your help.

(Whereupon, at 5:23 p. m., the subcommittee was adjourned.)

(Communications received by the subcommittee for insertion in the record are as follows:)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
Cambridge, Mass., May 9, 1958.

Senator HUBERT HUMPHREY,
United States Senate, Washington, D. C.

DEAR SENATOR HUMPHREY: It was my pleasure to hear you speak on the MIT campus last Monday. Even though I am not a very ardent Democrat, I found your lecture very stimulating, and several of your points reflected a thorough understanding of many of the reasons for America's wondrous failure to appeal to the minorities and backward peoples of the world.

The topic of this letter, however, concerns a subject where I am in disagreement with you. It concerns the establishment of a Department of Science and Technology. You requested comments on this subject, and here are my thoughts.

On the surface, it seems like a commendable idea, for I agree that this is probably a very inefficient method upon which we now rely. However, efficiency, in the general connotation of the word, is seldom characteristic of the outstanding scientist. The very sweep and breadth of the great scientist's mind reflects a revulsion toward channeling his abilities through one narrow channel, which would certainly be the most efficient method toward accomplishing one specific piece of research. Furthermore, in the midst of one line of investigation, the scientist might stumble onto a smaller problem which would lead him off on a tangent, and he would only return to the main line of reasoning after his probing desires had been satisfied, even though he might find himself in fields which have no practical connection with his main area of thought. I realize that you think of the economic aspects when you talk of efficiency, but I feel that any agency which is founded for this reason will carry this emphasis down through the various levels of control, until the working scientist would feel its chains enveloping his mind.

I believe that you stated that the Department would "advise" and "channel the efforts," which imply that the administrators would allot funds for specific purposes, expecting specific results. Yet it is well known that the major and most productive research centers in the country, such as Bell Laboratories and GE's research facility, do little to channel the efforts of their employees. They rather permit their scientists to choose their own areas of research, even though the results, if any, might not seem to be immediately applicable. Needless to say, this is also the approach which led to the great discoveries of Einstein and Dr. Teller. It is the only approach which will enable us to continue to lead Russia. On specific problems, Russia will eventually do far better, simply on the basis of their greater numbers. The mass can gradually advance the art.

But it is the individual who makes the sweeping discoveries which offset and make obsolete the efforts of the herd. Our hope should be that we can continue to develop minds which will be able to function in such a priceless manner. It is not a forlorn hope, for the freedom of the West as contrasted to the tyranny of Russia immediately gives us an advantage. But we would annihilate this advantage, and our society as well, if we were to take away the freedom of inquiry in research.

Naturally you would hope to retain this fertile atmosphere by permitting scientists to control the Department. But I look at the corrupt mayors who are made ambassadors and the scientific nitwit who is a so-called missile boss, and I wonder just how long we could hope for such a policy to continue. I am a graduate student in aeronautical engineering and so have some knowledge of those in the Government who control this field. I am discouraged. If the same problem developed in a department of science, we would be in for some very barren times. As our present policy stands, at least we have diverse agencies, most of which are in the control of men who understand the problems of those under them. I am thinking specifically of the NACA, which has done such invaluable research in the past. But as the process of centralization and consolidation continues, these men can no longer accomplish as much for those under them, but are themselves controlled by someone at a higher level. It is a fine structure for a business or a governmental administration, but I doubt its value in scientific research.

In short, we would save money in the short run, but what would the long run results be? If we could not retain the same atmosphere of scientific freedom, we would have wasted money, education, minds, and time.

Thank you for reading these thoughts, and I hope that I have made them clear They are exceedingly difficult to make convincing to someone outside of science, but their implications are so important to our freedom that it is well worth the effort.

Sincerely,

ROBERT E. KELLY.

DOCUMENTATION, INC.,
Washington, D. C., May 9, 1958.

Senator HUBERT HUMPHREY,
Chairman of the Subcommittee on Reorganization,
Committee on Government Operations, United States Senate,
Washington, D. C.

DEAR SENATOR HUMPHREY: I regret exceedingly that the pressure of other business called you from the hearing room on Tuesday, May 6, before I testified. The views expressed in the enclosed statement [1] differ markedly from those presented by most of the witnesses, and represent a position which might have been clarified and sharpened if I had had the benefits of your questioning. I know you will see it in the context of the total hearing, but I hope you will have an occasion to read it as a separate document and, perhaps, send me a brief comment.

You will note that the statement lists many samples of Government activity in the information field. Subsequent to my testimony, representatives of the National Research Council told of the following information activities carried on by the Council:

1. Prevention of Deterioration Center.
2. Office of Critical Tables.
3. Toxicological Information Center.
4. Geological Abstracts.
5. Chemical-Biological Coordinating Center.
6. Bibliography of Cardiovascular Literature.

Since these activities are also supported by the Federal Government, I believe this fact should be added as a note to the NRC statement. If this is not possible, can my own statement in the record be amended to include these additional important examples of Government-supported activity in the field of scientific information?

I make this point not in criticism of the NRC which has always responded effectively to Government needs in this field; but to emphasize that in the absence of a proper Government information agency, it is constantly necessary to call upon the NRC for information services which do not fall within the exclusive subject interests of existing Government agencies.

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[1] See testimony, p. 183.

I think your committee is beginning a long, hard, task paralleling the fight for the Department of Health, Education, and Welfare and the National Institutes of Health. I understand that the National Advisory Committee for Aeronautics, which you have many times mentioned as a prototype of the kind of Government activity which is required in the information field, finally got through as a rider to a supplemental appropriateion bill after being fought to a temporary standstill by standpatters.

You have my best wishes in your trailblazing—we will do anything we can do to help.

Faithfully yours,

MORTIMER TAUBE, *President.*

PRINCETON UNIVERSITY,
BOARD OF SCIENTIFIC AND ENGINEERING RESEARCH,
Princeton, N. J., May 16, 1958.

Senator HUBERT H. HUMPHREY,
United States Senate, Washington, D. C.

DEAR SENATOR HUMPHREY: Thank you for sending me the analysis and summary of S. 3126, the Science and Technology Act of 1958.

As a matter of fact, I had already received a copy of the committee print of this document and had been considerably disturbed by the comments on pages x and xi concerning the attitude of scientists. During a recent visit to Washington for a meeting of the American Physical Society I made some inquiries as to the source of these comments and heard a rumor that a number of scientists had been invited to testify but had declined. However, I was unable to identify anyone who had been invited although I specifically asked the officers of the Physical Society and of the American Institute of Physics who might naturally have received invitations. (Incidentally, I was president of the American Physical Society for the term ending in January 1958 and might therefore have been a natural person to invite.)

While I am by no means convinced that the proposal discussed in this document is a sound one, I am sure that my colleagues and I recognize the importance of the problem and would be glad to discuss it with you or the committee. I have not written you before because I gathered from various sources that S. 3126 as discussed in this document was not likely to be reported out in the near future.

I hope you will let me know if there is anything I can do to clarify these problems.

Sincerely yours,

H. D. SMYTH.

UNIVERSITY OF MICHIGAN,
DEPARTMENT OF POLITICAL SCIENCE,
Ann Arbor, May 16, 1958.

Hon. JOHN L. MCCLELLAN,
United States Senate, Washington, D. C.

MY DEAR SENATOR: I have, at last, been able to find the time to look over the excellent analysis and summary prepared by your staff, dealing with the proposed Science and Technology Act of 1958. Because of my continuing interest in the field of government organization, I thought I should, at least, make a comment to you in addition to thanking you for sending me the document. I am moved to say to you that I am completely opposed to the idea of setting up a separate Department of Science and Technology. Science is an area which should always be controlled by functional chiefs, and I only need to remind you of our experience on the first Hoover Commission when a well-known New York official who headed our Task Force on Public Works, came up with equally unsound proposals which would have put all kinds of public works functions in one department instead of leaving such engineering activities where they belong, namely, under the functional department heads. Science is an aid to the performance of other functions, and I can't imagine anything worse than to set up a Department of Science by itself, especially one headed by a scientist.

Cordially yours,

JAMES K. POLLOCK.

25589—58——19

WASHINGTON, D. C., *May 17, 1958.*

Hon. HUBERT H. HUMPHREY,
Senator from Minnesota,
Senate Office Building, Washington, D. C.

DEAR SENATOR HUMPHREY: Some time ago I seem to remember reading some remarks made by you in the Senate in reference to the printing of the document relating to proposed Science and Technology Act of 1958, and have since examined that document. I would wonder whether the statement on pages 3 and 4 of Senate Report 1430 on patents, trademarks, and copyrights as to the lack of availability of patents and information as to the state of the art in certain countries, especially of the so-called people's democracies, should not have great pertinence in the consideration of the proposed act. I would be rather inclined to suspect that the patents and information in question are not available anywhere else in the United States, much to the discredit of the state of official alertness in this country, and the proposed act as it now reads would probably do nothing more to remedy the situation than to insert a few more top policymaking individuals without a full understanding of the implications and of the way of trying to get something done about it.

In the very interesting document relating to the proposed act, I failed to find any statement of the organization of the Government in reference to such matters in the Soviet Union, and of the specific method of how far this similar plan has been carried out in detail in the various so-called people's democracies as a potentiality for making for unrest and trouble in the free world. Much of such information is openly published in official gazettes, law gazettes, and other official publications of the various countries, and its availability for use is only apparently contingent upon having such available and having a facility to understand the various languages and the official jargon, and is not in any way dominantly a matter of classified information. Having been in some of the countries in question, though not since the Second World War, and having followed steadily for some thirty-odd years matters of comparative Government organization and of official publications and their content over the same period, I venture to make this comment in view of your apparent keen interest in the matter.

With all good wishes, I remain,
Very faithfully,

JAMES B. CHILDS.

WASHINGTON, D. C., CHAPTER,
THE AMERICAN INSTITUTE OF CHEMISTS,
Alexandria, Va., May 19, 1958

Mr. WALTER L. REYNOLDS,
Staff Director, Committee on Government Operations,
United States Senate, Washington, D. C.

DEAR MR. REYNOLDS: I appreciate the copies of Senate bill S. 3126 which you sent to me a short time ago, for distribution to members of the legislative committee of the American Institute of Chemists. I found this bill very interesting, and in my opinion it is one of the most important pieces of legislation recently introduced in Congress.

At the last two meetings of the Washington chapter of the AIC, the bill was briefly discussed and the membership was quite interested, although previously they were ignorant of its provisions with the exception of Dr. Atkinson of the National Science Foundation. The group expressed informally a wish that our legislative committee study this bill along with several others and offer any aid at our command to your committee.

Since our last meeting the chairman of our local committee asked the president to appoint a new chairman due to his inability to give proper time to the group, and I was asked to head the group.

The American Institute of Chemists is composed of approximately 3,000 members, with the majority being from industry although the Federal, State, and local governments are fairly well represented along with a number of people in the field of education. In Washington our membership leans toward the side of Government chemists and chemical engineers but includes members from most of the industrial, research, and educational institutions in Washington and the surrounding area.

At the local level our legislative committee consists of Dr. Wessel of the National Research Council, Albert Parks of the Bureau of Customs, Fred Magnusson of the Bureau of Foreign Commerce, Paul Reichert of the Washington Gas

Light Co., Miss Madeline Berry of the National Science Foundation, and myself, of the Internal Revenue Service. Mr. Maynard Pro also of the Internal Revenue is chairman of the national legislative committee of AIC. Thus far we are not sure in what way we could be of service to your committee, but the group has indicated a willingness to spend considerable time and effort in studying this bill and other proposals of a scientific nature which have been presented to the Congress.

Since none of us have had legislative experience nor appeared before congressional committees, I think our first concern is to find out in what way we can be useful. We have set up a committee meeting for June 4 at 8 p. m. at Science Service Auditorium, 1719 N Street NW. and have invited several other chemists, not now on our committee, to attend. This meeting has been set up to formulate some plans and a work program. I wonder if someone from your organization could give us an idea as to what we might do either by letter or preferably meet with us. Miss Berry may also contact your committee in this regard as I believe she said some of her people were acquainted with the work of your committee; however, not having a firm commitment as to her plans, I thought I would bring up the idea as to what a group such as ours might do.

A lot of our scientists are talented individuals but in the field of planning and aiding in the setting up of Government programs our experience is negligible. I wonder if this did not account for the failure of scientists to aid in writing the bill for a Department of Science and Technology.

The following are a few personal comments on S. 3126. I am in fairly close agreement with the various proposals and agree that much of the direction of scientific work by the Government in the past has not been adequately directed. There is a definite need for a top level scientific organization which can adequately plan and carry out fundamental and applied research. The responsible personnel in this group should be capable of recognizing our needs and presenting them to the President and the Congress.

I think that it is very necessary that there be a continuing check by the Congress on any agency such as the Department of Science and Technology but I believe this is inherent in S. 3126. Often some of our most brilliant scientists have very little ability as directors of large-scale programs; their genius lies in their thought processes, concepts, and theories. Likewise close congressional watch may prevent undue emphasis on projects which are now operational but which will become obsolete when a new concept or idea is perfected. I particularly have in mind the chemical propulsion of rockets and space craft. Chemical fuels will probably continue to be the desirable propellents for short-range rockets, but in the space field, the perfection of nuclear powerplants, ion propelled engines etc., will make older forms of propulsion obsolete. Congress and the executive branch will both have to strive to keep the proper balance between basic research and applied science and engineering.

The concept of a number of scientific institutes is very sound. These institutes can form a nucleus for advanced study and work both in major programs and in limited fields which have been completely neglected in the past. For example, little has been done in the field of forensic sciences and the same is true in applying modern technology to the field of education. In this latter field it seems likely that better education can be obtained at half the cost of the present methods, wherein the greatest stress has been placed on the classical concept of more teachers and smaller classes.

I will appreciate hearing from you, particularly with reference to any work our group could undertake.

Sincerely yours,

Dr. Alex P. Mathers.

Engineers Joint Council,
New York, N. Y., May 19, 1958.

Mr. Walter L. Reynolds,
Chief Clerk and Staff Director,
Committee on Government Operations,
United States Senate, Washington, D. C.

Dear Mr. Reynolds: I want to say how much I appreciated meeting you last week and getting a briefing on your thinking regarding the Science and Technology Act of 1958.

I want to reemphasize my conviction that you will find the engineering groups quite openminded on this problem and, for the most part, well oriented to constructive changes.

In order to provide you with a bit more information about the Engineers Joint Council, I am enclosing herewith a copy of our most recent annual report.

With best regards, I remain,

Sincerely yours,

W. T. CAVANAUGH,
Executive Secretary, Engineering Manpower Commission.

WEST CHESTER, PA., *May 19, 1958.*

Senator H. H. HUMPHREY,
Washington, D. C.

DEAR SENATOR HUMPHREY: I was upset to read that hearings before your committee on S. 3126, Science and Technology Act (proposing a Government Abstract Agency) found no real demand.

I am assistant director of research for Foote Mineral Co., manufacturers of metal and chemicals. We employ 2 competent graduate librarians and have 60 research employees. To me the unavailability of scattered published information is a real threat to United States progress. Particularly since the best way to read about recent advances is to read the pertinent Russian abstracts on the subject.

I hope your committee was not sold a decision by translating and abstracting organizations who face a potential loss of business. Our experience with these organizations is that their efforts are too small to properly compile and index the flood of technical information.

Yours truly,

DAVID B. COGHLAN.

UNIVERSITY OF MARYLAND,
COLLEGE OF ARTS AND SCIENCES,
DEPARTMENT OF PHYSICS
College Park, Md., May 20, 1958.

MR. WALTER L. REYNOLDS,
Staff Director, Senate Government Operations Committee,
Washington, D. C.

DEAR MR. REYNOLDS: Senator Humphrey has sent me a copy of document 90 dealing with bill S. 3126.

I am seriously concerned with the inadequacy of research support in the universities and with the inefficient manner in which it is handled. For example, as the senior investigator of our research group I must spend about one-third of my time in scientifically unproductive activities in order to get sufficient support. As a consequence many of my colleagues have left the universities to go to places where research is supported.

Enclosed you will find a statement on "Basic Research and Advanced Training at Universities" given at the Yale conference last February, which reflects my views on the subject.

I am even more seriously concerned with the absence of facilities in the United States to provide advanced training in the space flight sciences. Since this represents my field of interest, and because of its obvious importance, I have written up my thoughts on the matter.

I urge you to examine the points of view set forth in the enclosed and to make them available to the committee members.

Sincerely yours,

S. F. SINGER.

BASIC RESEARCH AND ADVANCED TRAINING AT UNIVERSITIES

A summary of statements made by Prof. S. F. Singer, University of Maryland, at the Yale Conference on "America's Human Resources to Meet the Scientific Challenge" (sponsored by the President's Committee on Scientists and Engineers and the William Benton Foundation, held in New Haven, February 3 and 4, 1958)

WHAT IS BASIC RESEARCH?

At the outset, it is well to make as acceptable a distinction as possible between basic and applied research in the physical sciences. A distinction which is acceptable to many people is that applied research has an economic payoff which

is foreseeable, while basic research has its primary concern with a better understanding of the laws of nature and natural phenomena. It should be realized that much research is termed "basic" even though it is not, simply because the words "basic research" carry greater prestige value. For the same reason one must be careful when money figures are quoted for research and development, the basic research part is always a very small fraction of it.

The importance of a well-supported basic research program is too obvious to be elaborated here. Basic research is done by scientists who have an inquiring mind, are sincerely interested in learning about natural phenomena and who do not have to worry about their means of living. Since university scientists derive their income from teaching, a light teaching load enables them to devote a fraction of their time to basic research, to the writing of books and research papers, and other scholarly pursuits.

IMPORTANCE OF RESEARCH CONTRACTS AT THE UNIVERSITIES

There are four reasons, and perhaps more, why research support is of great importance to the universities.

1. Facilities have to be constructed, equipment has to be bought and technical help has to be paid for. But the facilities and opportunities for doing research attract and hold good faculty members in universities, men who might otherwise go into business activities.

2. Research activities at universities provide thesis opportunities for students. In order to obtain a doctor of philosophy degree it is necessary to carry out an original piece of research. If facilities were not easily available, many promising students would be discouraged from completing their training and would leave the schools at an earlier level.

3. The research grants usually provide assistantships and fellowships to graduate students. In general, this is their sole income during their graduate studies, which last 2 to 5 years. This income is quite small, of the order of $1,800 per year, but without it many promising students would not be able to pursue graduate work. Research grants also support undergraduate students and even high-school students who do technical work in connection with university research programs.

4. Lastly and most important, these basic research activities at universities produce the bulk of the basic research advances in this country and in the world. This is easily seen by taking a journal, such as the Physical Review (the major journal of the American Physical Society), and scanning the affiliations of the authors.

COST OF RESEARCH

If we measure the research output in dollars invested, i. e., even neglecting all of the educational advantages mentioned in the first three points above, the figure becomes even more impressive. This is so because university salaries are paid by the institutions, and are in general quite low, far lower than in industry. Overhead costs for buildings, maintenance, electricity, etc., are held very low and again are partly paid by the university. Finally, of course, there enters the competence of the investigators.

Here is a point which bears real examination: In a university atmosphere an investigator will not knowingly duplicate work which is being done elsewhere, for the very simple reason that his recognition depends on producing novel results. He will not spend time in needless repetition of work being done elsewhere. For example, a student working for a doctor of philospohy thesis even though he has put in much original work, has difficulty in getting such a thesis accepted if the same results have been previously published. In other words, university scientists in general do not do research to keep busy. This in contrast to some groups where research empires are being built up, mainly at Government expense, to present an impressive picture of the laboratory. In addition, "hoarding" of scientists and engineers, "raiding" of personnel by higher salaries (again at Government expense), as practiced by some companies, is extremely costly to our national research effort.

FEDERAL SUPPORT FOR UNIVERSITY RESEARCH

What is needed most is a different attitude toward university-type basic research. It should be realized that it plays a most important part both in strengthening the educational program and in producing scientific advances in this country. Without research support we cannot provide facilities to train

the young scientists the Nation needs. The money should be given in terms of grants rather than contracts, and every effort should be made to make these grants on a long-term basis to cover an effort extending over 3 to 5 years. The present system of year-to-year support with its fluctuations of funds is not suited for universities since they do not have a mechanism for smoothing out the fluctuations. Long-term support also encourages a more basic and more fruitful approach to research problems. It often takes more than a year to prepare the facilities and apparatus before any results are obtained.

It should be realized that universities are nonprofit institutions holding cost-reimbursement contracts and do not have funds to carry their personnel to the next fiscal year. Catastrophic effects to scientific research in universities were produced by the limitation of expenditures of the Department of Defense in the summer of 1957. The canceling and slowing down of research contracts therefore resulted in important research being curtailed or halted, experienced research teams being broken up and dispersed, and training of future scientists seriously jeopardized. And good professors and scientists are leaving the universities to work where they will not have to worry about the instability of the research support.

There is also a need for large-scale support to establish major research facilities, such as cyclotrons, radio telescopes, etc. There is an important area for Federal concern to be sure that important segments of the physical sciences are not neglected. An outstanding example perhaps is the field of the space-flight sciences where, because of lack of facilities, advanced training is seriously handicapped.

Much has been said of support of basic research and of advanced education in industry. This support varies widely among different companies. Some companies support really basic research in their laboratories on company funds. At the same time they grant fellowships to universities to give to promising students without regard to the research the student is doing and without any obligation on the part of the student to the company. On the other extreme, we find companies gathering basic research contracts from Government agencies on the basis of impressively prepared proposals, with these contracts being handled by second-rate people who often do not know enough about the subject to be aware of previous work in the field. Such companies do not even have real libraries; their library consists of a collection of classified reports by other companies who worked on similar Government contracts. The research sometimes simply consists of regurgitating all of the previous results and presenting them in a somewhat different form. This is very often done on the so-called study contracts, and the only conclusions that the report comes up with is that further money and effort would be required to make more extensive studies so that the project "can be put into the hardware stage." Some of these same companies also support advanced education for their engineers and physicists. They are first put on the company payroll and then sent to graduate school. During the summer they spend a few weeks with the company. In return, the company charges their salaries to a Government contract and collects, in addition, 100 percent overhead from the Government. This type of practice has lead some of the more responsible universities to refuse acceptance to such students even though the student himself is perfectly qualified to undertake graduate work.

THE NEED FOR ADVANCED TRAINING IN THE SPACE-FLIGHT SCIENCES

An effective reply to the Russian challenge in science and space technology involves many different aspects, but there is one facet which interests me particularly since I am intimately acquainted with it. That is the need for advanced training in the space-flight sciences for promising young men. I believe that now is the time to start so that we will have men of the right caliber available 2 to 5 years from now to play an effective part in space-flight programs in industry, Government, and university laboratories. This type of doctor of philosophy is now being produced at the rate of perhaps two per year for the whole United States and Western Europe, a shockingly low rate. I think that a more adequate number would be 20 per year in the next 5 years, and 100 per year thereafter.

University laboratories can contribute in major respects to the advanced training in the space-flight sciences: (i) by giving advanced training to students on the graduate level on the technical aspects of astronautics, and (ii) by stressing the astrophysical aspects which provide the ultimate justification for space research and give the student the necessary background for space research.

One reason why so few people are being trained in this field now is the non-availability of suitable facilities for space research at universities. You cannot

train nuclear engineers unless universities have research reactors; you cannot turn out nuclear physicists unless they have access to nuclear accelerators. Astronomers must have telescopes, radio astronomers must have radiotelescopes. I maintain that in order to produce doctors of philosophy with emphasis on the space-flight sciences we need a more extensive program of high altitude exploration with small research rockets at universities. Such research programs would attract good caliber men into this field. In addition, the Armed Forces need to train some of their best young officers in this field of space physics. And finally, we must give our NATO allies opportunities to train their best young men in rocket and satellite work.

CURRICULUM

There is a very great need for men with advanced training in the space-flight sciences. This training should be broad enough so that the man can handle both the technical aspects of the work and is also familiar with astrophysics. In my opinion such a curriculum leading to a doctor of philosophy in physics with specialization in the space-flight sciences must be based on a very broad study of the fundamental subjects of physics, both classical and modern, followed by detailed courses on those topics which are of importance to astronautics. Such a proposed curriculum is shown in figure 1.

In order for the university department to offer a wide variety of the specialized topics following the basic courses it needs a fairly large enrollment of students. This speaks for the concentration of space-flight training into centers rather than spreading it out over too large a number of institutions. A reasonable number of graduate students would be 40 to 50 which would take a staff of perhaps 10 scientists working in the space-flight sciences and teaching the specialized topics, in addition to physicists who teach the basic courses.

NEED FOR A RESEARCH PROGRAM

It is important to realize that the best way and perhaps the only way for a man to become educated is to do research under proper supervision and guidance. The original research required for a master's thesis and especially for a doctor of philosophy thesis is one of the most valuable educational experiences which a student gets. Therefore, the training has to be tied up very closely with an active program of research in the space-flight sciences carried on concurrently and providing many thesis topics for the students. Since there is little rocket research and no satellite work in Europe, there appears to be a special need for centers in the United States where NATO scientists can work on exchange fellowships both pre-doctor of philosophy and post-doctor of philosophy. Such NATO researchers or lecturers could be easily integrated into a department where adequate emphasis is placed on the space-flight sciences. The interchange and cross-fertilization produced by these visitors is of course invaluable for the education of students as well as for the strengthening of the scientific capabilities of both the host institution and the visitors.

ROCKET FACILITIES

In order to carry out an adequate research program substantial facilities are required. One of the most important are facilities for upper atmosphere and outer space research. This program has to be based on small and cheap rockets since large rockets are nor very feasible for instructional purposes. With small rockets, however, the student can take over a complete rocket experiment and carry on all phases of it himself, from the initial planning to the construction of the experiment, the firing of the rockets, and the analysis of the results. To give an example of the cheapness of some current rockets, we only mention the Oriole, a 100-mile rocket which we can build for $500, the Terrapin rocket which reaches an altitude of 200 miles at a cost of $2,000, the Curlybird which can reach an altitude between 600 to 1,000 miles (depending on payload) at a cost of $4,000. Experiments, of course, contribute not only to the training of the students but give important research results about the state of the outer atmosphere and the nature of the radiation which comes in from outer space. Such information is of vital importance for the development of astronautics.

By subcontracting, it is possible even within a university setup to construct simple rocket vehicles which can go to altitudes of the order of 10,000 miles (2½ earth radii) for a cost of approximately $50,000 per firing. This is a very low cost indeed considering the extreme altitudes and the many new research results which can be gained in a region which has never been explored.

It goes without saying that such a program interferes in no way with missile programs. In fact, it enhances them by providing data about the environment which is of importance to missile designers. And of course the students graduating from this course of training are in a unique position to make important contributions to the guided-missile field.

It should be stressed also that these small rockets can be fired from improvised test sites and do not, in fact, should not be fired from missile proving grounds. Typical research objectives are the following: The intensity and the variation of solar ultraviolet and X-rays; the nature and intensity of interplanetary dust; the composition and altitude variation of the primary cosmic rays; the nature and intensity of the auroral particles; the measurement of electric current systems in the ionosphere and outer atomsphere; the density and temperature of the outer atmosphere, many thousand miles from sea level.

OTHER FACILITIES

But not all of the investigations require rockets. Many should be carried out in balloons which can spend long times at relatively low altitudes, of the order of 100,000 feet. Other experiments again are best carried out in an airplane. For a research effort of this magnitude a balloon launching station and geophysical research plane should be made available.

In addition, laboratory facilities are necessary. The main one would be a small optical observatory for planetary observations including spectroscopic equipment, particularly in the infrared. Fast spectrographs are required also for the study of the aurora and airglow. Other important facilities for research and training are radio equipment for measuring cosmic radio noise and antennas for measuring the so-called radio whistlers and low-frequency emissions from the earth's outer atmosphere.

Much of the laboratory effort will be of a supporting nature in the field of electronics, in particular microminiaturization. Atomic physics experiments are important. A shock tube for example is a useful facility. Spectroscopic equipment is needed, particularly for the far ultraviolet region.

COSTS

An adequate program can be set up and maintained with a yearly budget of $1 million. This operation would pay the usual assistantship salaries (or fellowships) to 40 graduate students (assuming a 2-year thesis period), the salaries of research supervisors, and special lecturers. This budget covers the cost of setting up a small launching facility on the coast and includes ground-support equipment, such as radio telemetering and tracking stations.

CURRICULUM FOR ADVANCED TRAINING IN THE SPACE FLIGHT SCIENCES

Theoretical mechanics: Celestial mechanics, moon orbits, space navigation, guidance (inertial, gyroscopic effects, stellar).

Fluid dynamics: Dynamic meteorology, oceanography, aerodynamic flow, hypersonics, shock waves, turbulence, rocket propulsion, magnetohydrodynamics.

Electrodynamics and magnetohydrodynamics: Radiowave propagation, ionosphere, radio telemetering and control, information theory and noise radioastronomy, origin of cosmic rays, magnetic storms and Auroras, interplanetary physics, physics of ionized gases, fusion reactors, plasma jets.

Statistical mechanics: Thermodynamics, high-temperature gas dynamics.

Relativity: Cosmology.

Quantum mechanics: Spectroscopy, radiation transfer, stellar atmospheres.

Atomic physics: Photochemistry; atomic collisions; upper atmosphere physics; physical meteorology, planetary (atmospheres); spectroscopic instrumentation; atomic beam devices; optical pumping.

Solid state physics: Radiation detectors, semiconductor devices, MASERS, high-pressure phenomena, physics of the earth's interior.

Nuclear physics: Fission and fusion physics, high-energy (Meson) physics, stellar evolution, origin of elements.

GRADUATE COURSES IN THE SPACE-FLIGHT SCIENCES GIVEN AT THE UNIVERSITY OF MARYLAND, 1953 TO PRESENT

1953–54:
Fall:
Physics 244: Aerophysics (Resler)
Physics 230: Cosmic ray physics seminar
Physics 248: Cosmical electrodynamics (Alfvén)
Spring:
Physics 249: Cosmical electrodynamics (Alfvén)
Physics 230: Cosmic ray physics seminar, high-temperature gas dynamics (Resler)
1954–55:
Fall: Physics 230: Upper atmosphere physics seminar (ionosphere)
Spring: Physics 230: Upper atmosphere physics seminar
1955–56:
Fall: Physics 230: Problems of earth satellites and high-altitude research
Spring:
Physics 226: Theoretical hydrodynamics (shock waves) (Resler)
Physics 230: Interplanetary physics seminar
Physics 231: Applied physics seminar (Burgers), (magnetohydrodynamics)
1956–57:
Fall:
Physics 248: Physics of ionized gases
Physics 231: Gas flow at high temperatures (Burgers)
Spring:
Physics 249: Physics of meteors (Öpik)
Physics 231: Gas flow at high temperatures (Burgers)
1957–58:
Fall:
Physics 230: Upper Atmosphere Physics Journal Club
Physics 221: Topics in astrophysics (spectroscopy and radiation transfer)
Spring:
Physics 230: Upper Atmosphere Physics Journal Club
Physics 248: Radio astronomy

J. T. BAKER CHEMICAL CO.,
Phillipsburg, N. J., May 21, 1958.

Senator HUBERT H. HUMPHREY,
Chairman, Subcommittee on Reorganization,
United States Senate, Washington, D. C.

DEAR SENATOR HUMPHREY: The recent hearings on S. 3126, the Science and Technology Act of 1958, were summarized in Chemical and Engineering News for May 19.

I would indeed appreciate receiving the transcript of these hearings and of any future hearings and reports on this Senate bill.

I personally feel that this proposal merits serious consideration by scientists, and by the public generally. We are indeed rapidly reaching a point where private funds cannot underwrite and effectively coordinate the storage, indexing, abstracting, and retrieval of scientific and technological information. Of course, the proper balance between the encouragement of existing nonprofit and commercial informational services and the establishment of new Federal services would be an administrative problem that would require detailed study.

Sincerely yours,

A. J. BARNARD, Jr., PH. D.,
Director, Technical Information.

[From the New York Times, May 15, 1958]

Soviet Amasses Scientific Data

SPECIAL INSTITUTE PREPARES DIGESTS OF TECHNICAL PUBLICATIONS OF WORLD

By Max Frankel

Special to The New York Times

Moscow, May 6.—A Soviet biologist somewhere in Siberia could snuggle up in bed and read comfortably about the whistling habits of bobwhites in Iowa, the annual report of the Calcutta inland fisheries research station, a Japanese study of the effects of radioactivity in Bikini waters, and the isolation of a rabies virus from native Ohio bats.

He has these and 4,863 other summaries of biological developments throughout the world available in a single 530-page book. And he had better read quickly because a volume of equal size is forthcoming every 2 weeks.

The man's chemist friend across the street or down in Central Asia gets a different series of volumes. There is one of interest and importance for virtually every Soviet scientist or technician whatever his primary interest.

There are the famous Soviet abstracts, famous because a world suddenly aware of the Soviet Union's technical prowess has been inquiring into Soviet scientific techniques and whispering suspiciously about Moscow's organized effort to pirate every formula and watch every butterfly catcher in the world.

There is apparently nothing mysterious about the abstracts. At least their editors have honored a 5-month-old request to discuss their work.

They spend 50 million rubles annually to peruse 16,000 scientific publications—titles, not issues—from 88 countries. They produce from these publications half a million 100-word summaries for organized and indexed publication in 13 different series of the Abstract Journal of the Soviet Academy of Science.

In addition, they publish 36 biweekly journals for specific industries. These range from atomic energy to welding industry and contain reviews of the "most considerable works" abroad. The journals are illustrated with pictures, diagrams, drawings, and tables.

And, if a real rush develops for something, the editors will undertake a specific project, such as a recent compilation of everything new in the design of buses for a Soviet factory planning a new model.

Nearly 14,000 persons, including 1,500 full-time employees of the publisher, the Institute of Scientific Information, work on these projects. Among them are some of the Soviet Union's leading scientists, and some of its best linguists, since the tapped sources come in 50 languages.

The purpose of the Scientific Information Institute is simple: to study, review, summarize, publish, and catalog every scientific and technical development in the world and to make this information available to Soviet science and industry and to anyone abroad who can read Russian.

Dr. Aleksandr Mikhailov, director of the information institute, notes that at present in many fields of science it is easier to stage an experiment anew than to search through literary sources to find a previous discussion of the problem. That is the situation the institute is out to correct.

It wants to develop the art of abstraction to the point where a scientist can daily keep abreast of the developments in his field around the globe. And it wants to develop the techniques and machines to be able to brief him thoroughly on the history of a scientific problem and to provide him with all available published material thereon.

The project was conceived by and has had the influential backing of Dr. Aleksandr N. Nesmeyanov, president of the Academy of Science. Five years ago researchers began to study less ambitious abstracts published in the United States, West Germany, and elsewhere and found that without exception they bore fruitful results. Unquestionably, therefore, they concluded, the best results are to be found from an abstraction service developed to its logical end, covering every known field and drawing on every known source.

At present the institute publishes semimonthly abstracts entitled "Biology, Machine Building, Chemistry, Biological Chemistry and Electro-Technology" and monthly journals called Astronomy and Geodesy, Geography, Geology, Mathematics, Metallurgy, Mechanics, Physics and Geophysics. By next year it hopes to add Medicine and Public Health, Agriculture, Transport, and Ore Enrichment to the list.

The journals are printed on cheap paper and bound in stiff gray paper and read like a collection of index cards in a library.

The current 530-page biology journal costs 28 rubles 80 kopeks, or $691.20 for a year's subscription to 24 issues. It is subdivided into 19 areas from palaeontology to pharmacology and toxicology, which, in turn, are divided into such specific fields as forest management, insects, wildlife conservation, and metabolism.

[From the New York Times, May 18, 1958]

"Where Do We Fit in?" the Scientists Ask

Answering Washington's call for help, they seem baffled and lost in a bureaucratic labyrinth. A way out, leading to more efficient work for the Nation, is not easy to find

(By Theodore H. White)

It is now 7 months since "Sputnik Day," October 4, 1957, when the care and health of American science suddenly became as important a subject of national debate as inflation, desegregation, foreign aid, and full employment.

Since then, under a torrent of concerned and worried words, much has been swiftly achieved. Three American satellites wheel in orbit. A thousand American communities are rearranging school curricula to produce more scientists. The President has added to his staff an official science adviser. Science, finally, has become enshrined, a national cliché—a very important thing.

What more could scientists ask of a nation which has seemed, for months, to hang on their every word?

Odd as it may seem, they want the answer to a very simple query: "Where do we fit in?" This question, dismaying and harassing them for years, baffles them just as much today, since the sputniks as before. For, though everyone knows that some sort of partnership in national planning and policymaking must exist between scientists and Government, scientists still do not understand the terms of the partnership. Moreover, they believe Government understands even less.

Today we spend a greater percentage of the national income on scientific research and development than we did at the height of World War II. With these funds, the country has built in the last decade an unprecedented Government-controlled-or-supported apparatus of science. But the Nation has yet to wire this apparatus into the councils of policymaking in any way that effectively helps it shape national decision.

Between scientists and Government there stands today an almost indescribable labyrinth of bureaucracy. And to anyone watching scientists trying to operate in Washington, as this correspondent has done for several weeks, it sometimes seems that a generous but thoughtless Government has set up an obstacle race which scientists must win, not be brilliance, but by groping, bumping, and pushing.

No fewer than 38 executive agencies dealing wholly or partly with a wide range of scientific activities now report, in theory, to the President. In fact, they have only the most perfunctory relationship with the source of final decision, the White House; few or none of their problems ever reach the President at all.

Beyond and about these executive agencies is a penumbra of countless overlapping, conflicting committees of scientific advisers and coordinators; the National Science Foundation listed a hundred-odd major ones in 1956 and made no attempt to name the scores, or even hundreds, of lesser committees. One of America's most eminent scientists, a member of half a dozen such groups, said recently: "Practically all these damn' advisory committees are window dressing. No one works. You come into Washington for 1 day to talk and be talked to; you spit out a lot of platitudes with great clarity and go back to your own shop. Big national problems in science are too tough to be judged by advisers in 1 day on the run."

Since the military, controlling between 60 and 80 percent of all Government funds appropriated for science, has become the chief patron and employer of American scientific endeavor, it is toward the Pentagon that the anger and bitterness of most scientists, rightly or wrongly, are directed. Advisory panels, subcommittees and coordinating scientific groups cascade down the tables of organization under the Department of Defense, linked horizontally, vertically, diagonally, and three-dimensionally. Beneath these, some 90,000 paid scientists and engineers—probably 35 to 40 percent of all American creative scientific

manpower—work across the country on projects directly concerned with military hardware.

Whether as eminent advisers or payroll employees, these scientists must try to influence American national policy through the indirect and narrow channels of uniformed bureaucracies which interpret their discoveries to the civilians with the power of final decision. And scientists—who consider their own opinions in this fast-changing world as vital to policy as those of military men—feel they must be cautious, almost docile, in threading their ideas through the military. For the military can, out of budgetary necessity, sheer ignorance, or pique, cut off or divert funds on which the progress of national science and the country's security depend.

The situation is, of course, acutely uncomfortable for the military officers who bear the brunt of the scientists' criticism. Their primary function, they protest, is to protect the Nation, by their plans and with their resources, against the enemy, not only 10 years hence but today. They must balance the scientists' urgencies about the future against the urgencies of immediate or fast-approaching peril. Each service must conscript scientists to work on the specific mission for which it is responsible, even though duplication or conflict results. All too often military men must judge between the advice and theories of passionately conflicting scientists. Above all, they must think of science in terms of technology and tools, not as broad adventure into a future which may reshape man and society.

For the scientists, the situation is, at the least, humiliating and frustrating.

"It's never been a shortage of brilliant science that's held us up," says a staff member of the President's Supreme Science Advisory Committee. "The brilliant, the superlative, the merely good ideas have all stewed around without any efficient way of distinguishing among them."

"This country has been trapped," says Dr. Albert Hill, chief of the critically important Joint Chiefs of Staff Weapons Systems Evaluation Group, and a distinguished scientist in his own right, "in this funny impedance race between good science and bad management."

"We have been treated," says Dr. I. I. Rabi, Nobel Prize winner and one of the architects of American defense in the nuclear age, "as alchemists were treated by medieval kings, the way German princelings treated strange wise men showing their wares."

How, in a nation that first released nuclear energy, excels in advanced technology and has so lavishly supported science, did this confusion come about?

The answers lie in the past 15 years, a period in which the influence of science on national policy has receded almost as fast as the exploration of science has moved forward.

Fundamentally, the story starts with the wartime OSRD, the great Office of Scientific Research and Development, perhaps the most effective mobilization of scientific brains for national survival that any nation ever achieved.

The OSRD was a governing body within science itself, empowered to sit as a high court of judgment on the sometimes conflicting theories of American scientists. It was independent of any other agency. It was linked directly to the White House, with authority to speak up whenever it believed science could contribute to the broad national interest. And it confronted actual wartime needs and problems.

"The OSRD was operational," says a man who worked with it. "If we had been an advisory committee to Army, or Signal Corps, like today, nothing would have been done. We decided what was the most inviting point of breakthrough. The White House approved the funds we budgeted. The engineers built the facilities we needed. We contracted directly with industry and universities to do what we had planned. Then, when we were ready, we'd turn the stuff over to the proper military agency for use."

"We had a hardness to our problem then," says J. Robert Oppenheimer. "We knew the shape of the war in Europe and its strategy; there was unanimous clamor for real weapons with real use."

The end of the war ushered scientists into a new era. The "hardness" of simple combat strategy and requirements was replaced by the cultural competition and ideological warfare of a "peaceful" revolutionary world. At the same time, nature's frontiers began to recede at an unimagined pace; science exploded with intellectual energy, requiring for its work such great sums of money that only the national budget could provide them.

At this juncture, OSRD was dissolved. Not that an ungrateful Nation spurned its scientists. Quite the contrary. A conversion to science had taken place, particularly on the part of the military. Dr. James B. Conant describes

it as a "fanatic enthusiasm for research and development * * * not unlike that of old-fashioned religious conversion."

But the role of scientists was grossly changed from the days of the OSRD. Instead of controlling their own explorations, settling their own scientific differences and speaking directly to the White House, they found themselves enlisted in advisory panels, groups, and committees responsible to civilian agencies or military services. Their funds, even their careers, became dependent on the men they advised. Their mission was increasingly confined to what a single agency wanted and could afford, rather than the strategy and statecraft of the whole Nation.

"The classic Pentagon directive," says Lloyd Berkner, one of the sages of science-in-defense, "is that research and development programs meet military requirements. Whereas actually, in this day and age, it should be the other way around."

The two most discussed episodes in the story of postwar American science—the rocket foul-up and the Oppenheimer case—both resulted directly from the confusion and breakdown in the partnership of science and Government.

For years, the triple problem involved in rocketry—that of tooling a warhead down to a proper size, fitting it to a sufficiently powerful propulsion system, then equipping the rocket with a proper guidance mechanism—was debated by many overlapping groups, with no one coming to an overall national decision. Cramped by their own narrow service roles and budgetary limitations, balancing current defense needs against future imponderables, the Armed Forces proceeded in fits and starts.

For example, the Air Force completely halted research on the parent of the present ICBM in 1947, reactivated the program only in 1951, and did not go into high until 1954. Similarly, the Naval Research Laboratory twice completely dissolved the complicated teams of scientists working on the rocket which was the direct precursor of the laggard Vanguard missile. Yet no high court of scientists like the OSRD could carry the whole problem directly to the White House for clean-cut decision.

The Oppenheimer case is cited by many scientists as an example of what could happen if they tried to as as if the OSRD still existed. For the General Advisory Committee of the Atomic Energy Commission, which Oppenheimer led in its postwar period, was the only heir to the tradition of the OSRD. Sitting beyond the control of the service arms, the General Advisory Committee created the superiority in nuclear weapons on which our national strategy still hangs; debated and set the priorities to be given nuclear submarines and airplanes: challenged and broke the Air Force monopoly on the uranium bomb, and sent the mission to tell Eisenhower at SHAPE in Paris that nuclear ground weapons would soon be available for the ground defense of Europe.

It was in the General Advisory Committee that the great argument over the hydrogen bomb began.

Out of the tangle of issues aired in the Oppenheimer hearings—the technology of nuclear science, the national resources then available, the police charges arising from that period's McCarthyism—these facts rise clearly: The nuclear scientists, rightly or wrongly, had been debating the H-bomb in terms of the whole sweep of national policy; they disagreed personally and bitterly among themselves, and these disagreements were amplified yet further by disagreement among other Government organs.

No one can plow through the 992 fine-print pages of testimony at the Oppenheimer hearings without realizing how much more crushing for the scientist was the Air Force testimony—based purely on highest-level policy disagreements—than the security charges on which the final decision against Oppenheimer was technically based. Neither Oppenheimer nor the Air Force had worked in a partnership that clearly defined the scientist's role, protected both partners and gave them clear access to a final arbiter if vital differences arose. When the Air Force finally aired its opposition to Oppenheimer, it had to do so at a public police court. Both scientists and the military were trapped; a vital but legitimate difference of opinion was completely obscured in the maze of procedure.

Says a man who was an Assistant Secretary of the Air Force at the time of the trial: "It was like performing an appendectomy with a crowbar."

Many scientists insist they learned from the Oppenheimer case only this: To stay carefully within the confines of their mission and sponsoring agency and not let their minds range over the totality of the Nation's problems.

"Several years ago," says a member of the President's Science Advisory Committee, "we would have argued over the nuclear airplane from hell to breakfast.

Now, if the Air Force wants a nuclear airplane, we say, give it to them; it's only money. Why get into a fight?"

The debate over the thermonuclear bomb has long receded into the past; the debate over the sputniks is fading too.

But urgent questions involving science and national policy succeed them. Is is safe to explode a thermonuclear warhead beyond the blanket of our own dense air? Who will decide whether the National Science Foundation, the Atomic Energy Commission, or the Department of Defense ponies up the money for the new multibillion-volt accelerator American physicists have insisted for a year they need? Can we beat the Russians to an efficient process for desalting sea water? Or would a crash program for solar energy be better for our diplomacy in Asia and Africa? Can we push both efforts at once? What of the sciences of life and death? Should we intensify research on a high-protein grain for countries where a few eat meat? Should we mobilize our scientific brilliance in biology and medicine for impact on this world's strange politics?

Above all: Who is to answer these and similar questions?

In the past 6 months, the chief—and only—positive step taken to pull order out of chaos has been Eisenhower's appointment of Dr. James R. Killian, president of Massachusetts Institute of Technology, as his personal adviser, Chairman of the reorganized Presidential Science Advisory Committee, and ex-officio member of the National Security Council.

A brisk, incisive man with the manner and dispatch of a brilliant surgeon, Killian has performed well since he took up residence in Washington. He has achieved a personal relationship with the President that carries him trotting across the street from the old State Department Building to the White House 2 or 3 times a week. He has brought about the appointment of a supreme science adviser to NATO. He has acquired the authority to intervene, a friend in court, when the many scientists in and around Washington need help with strangling budgets and bureaucracies.

Despite their respect for Killian, the attitude of most scientists toward his appointment is still one of friendly reserve; they are waiting to see exactly what his jurisdiction and authority will be. Instead of being able to bring calm, unhurried judgment to the President, Killian has so far been swamped with emergency business. His permanent staff of 5 or 6 is dreadfully inadequate. The eminent scientists he has been conscripting for emergency guidance and consultation give their time unstintingly, but complain they cannot continue to leave their own responsibilities and race to Washington. Most serious of all, Killian has no funds of his own, no real organization and no authority except the right to intercede directly with the President when affairs reach deadlock or crisis.

Scientists are agreed on the principle, but not the blueprint, of the new partnership they want with Government. A few of those with longest experience in Washington want a full-scale Department of Science and Technology, to bring under one executive head all purely scientific agencies such as the AEC, the National Science Foundation, the National Committee on Aeronautics, the Bureau of Standards, the Weather Bureau, etc., leaving to the traditional Government departments only the essential service functions of science.

Dissenters, believing that a Department of Science smacks of too much discipline and centralization, want an expansion of the present Killian office by giving it greater executive authority, a much larger staff and independent funds.

However much they disagree on forms and organizational boxes, scientists are unanimous in wanting to be told clearly where they fit in, and to be given independence of action clearly commensurate with the role they must play in the Nation's policymaking.

It seems obvious that the reorganization of the partnership must begin in the two divisions of Government that shape our politics—the executive and Congress.

Only congressional discussion and investigation can clarify what scientists need in order to work efficiently for the Nation. At present, faced with a conflicting mass of figures from many agencies, Congress has no way of judging what share of the country's resources go to science, and who is spending it. A congressional demand that all science's requirements be packaged together for one consideration would force the creation of new congressional Committees on Science and Technology, equal in power and prestige to those on Military Affairs, Foreign Affairs, and Atomic Energy. Only such committees can generate the vital political pressures which make Washington act.

But beyond a corps of champions in Congress, science needs, under whatever name, an independent, operational place in the executive structure. Only from such a base can disputes within science be intelligently settled; only from its shelter

can scientists speak freely and safely on broad national problems. Though an adviser on science is as necessary to the President as military and economic aides, he cannot take the place of an organized understructure of scientists within Government who can join in the discussion and debate of broad policy before final decision.

There is as yet no name for a reorganized partnership of science and Government, because there is no name for the new kind of world we live in. But the insistent fact is that a name and an accommodation must be found.

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